FS/RV SONNE

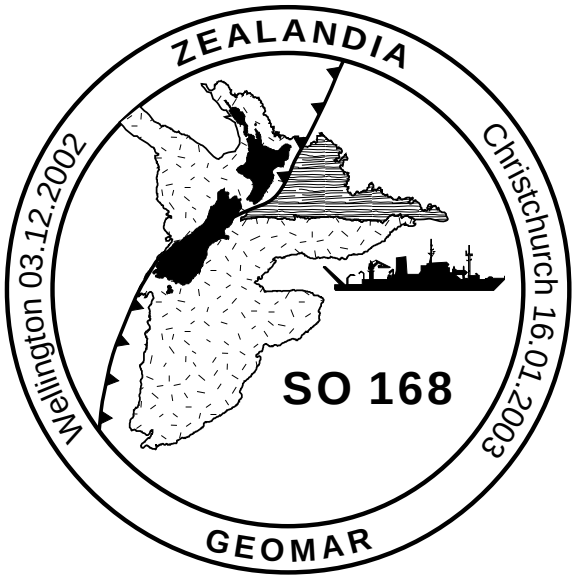
FAHRTBERICHT SO168
CRUISE REPORT SO168

ZEALANDIA

CAUSES AND EFFECTS OF PLUME AND RIFT-RELATED CRETACEOUS AND CENOZOIC VOLCANISM ON ZEALANDIA

WELLINGTON - SYDNEY - LYTTELTON/CHRISTCHURCH

DECEMBER 03, 2002 - JANUARY 16, 2003



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Edited by
Kaj Hoernle, Nicholas Mortimer, Reinhard Werner, and Folkmar Hauff
with contributions from cruise participants

GEOMAR
Forschungszentrum
für marine Geowissenschaften
der Christian-Albrechts-Universität
zu Kiel

KIEL 2003

GEOMAR REPORT 113

GEOMAR
Research Center
for Marine Geosciences
Christian-Albrechts-University
in Kiel

Redaktion dieses Reports:
Kaj Hoernle, Nicholas Mortimer,
Reinhard Werner, and Folkmar Hauff

GEOMAR REPORT
ISSN 0936 - 5788

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Wischhofstr. 1-3
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GEOMAR REPORT
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1. CRUISE SUMMARY/ZUSAMMENFASSUNG DER ERGEBNISSE

The *RV* „Sonne“ 168 ZEALANDIA cruise officially started in Wellington, New Zealand on December 3, 2002 and ended in Lyttelton/Christchurch, New Zealand on January 16, 2003. From December 3-16, the *RV* „Sonne“ transited to and from Sydney, Australia as part of the GEO Year 2002 sponsored by the German Federal Ministry of Education and Research. The scientific program was carried out between December 15, 2002 and January 14, 2003 and included mapping and sampling of the Challenger and Hikurangi Plateaus, the Chatham Rise and the sea floor north of the Hikurangi Plateau and north and south of the eastern Chatham Rise.

Bathymetic Mapping and Hard Rock Sampling

Prior to the *RV* „Sonne“ 168 cruise only one dredge haul, containing volcanic and volcaniclastic rocks, had ever been recovered from the entire Hikurangi Plateau. No samples at all had ever been obtained from the eastern third of the Chatham Rise, or from the Pacific ocean crust adjacent to the Hikurangi Plateau and Chatham Rise. Samples were obtained from all of these areas on the SO 168 cruise. Out of the 95 dredges, 6 TV-grab stations and 4 box cores on the cruise, 77 contained igneous, metamorphic or sedimentary rocks (excluding dropstones), 48 Mn-Fe oxides, 62 soft sediments and 73 biological material.

As suggested by the successful sampling program, the *RV* „Sonne“ 168 cruise achieved its major goals: to obtain a detailed sampling of 1) the Hikurangi Plateau, including the base of the plateau as well as seamounts sitting on the plateau, 2) volcanoes associated with the rifting of the eastern part of Zealandia from Antarctica, and 3) Cretaceous to Neogene intraplate volcanism along the entire length of the Chatham Rise. The sampling of the Hikurangi Plateau probably represents the most detailed marine sampling of an oceanic Large Igneous Province to date. Seamounts on the ocean crust adjacent to the Hikurangi Plateau were also sampled.

The SIMRAD mapping and sampling by dredging allowed several preliminary conclusions to be drawn about the origin and evolution of the Hikurangi Plateau and about Cretaceous to Neogene volcanism on the northeastern edge of Zealandia. On the Hikurangi Plateau volcanic samples were basaltic, with generally equigranular fine- to coarse grained basalts obtained from the plateau basement at the Rapuhia Scarp, and olivine-porphyritic vesicular basalts from seamounts constructed on the plateau basement. Two distinct types of volcanic seamounts were discovered on the Hikurangi Plateau. Guyot-type seamounts generally occur within the plateau. These volcanoes must have once formed islands that were subsequently eroded to sea level. The similar elevations of the erosional platforms above the sea floor (~1,050 m) suggest that the volcanoes have similar ages and that the depth of the Hikurangi Plateau was once uniformly about 1,500 m below sea level, using sediment thicknesses from seismic data. The depth of the erosional platforms (3,300 – 1,600 m) and of the base of the volcanoes (4,200 - 2,700 m) increases systematically toward the Rapuhia fault scarp (northeastern boundary of the plateau), indicating greater subsidence near the fault scarp since the formation of the platforms. The second group of seamounts are constructional volcanic ridges and are located on or near the northeastern boundary of the Hikurangi Plateau. They are interpreted to have formed along faults and generally their elongations are subparallel to the local strike of the northeastern plateau boundary. Ridge-type volcanoes can occur more than 70 km from the northeastern plateau margin. Mapping of the Rapuhia Scarp showed that it consists of multiple tilted fault blocks, rather than a single fault. In conclusion, the greater subsidence along the faulted northeastern margin and evidence for fault-controlled volcanic ridges at least 70 km into the plateau indicate rifting and rift-related volcanism. The features are consistent with the hypothesis that the Hikurangi and Manihiki Plateaus once formed a combined plateau which was subsequently broken apart with new seafloor being formed at the Osbourn Trough (a paleo spreading center) now halfway between the two plateaus.

The Wishbone Ridge appears on global gravity maps as a forked 1,300 km long negative gravity anomaly. A 53 km long, very steep-sided, flat-topped ridge was mapped in the Wishbone feature and has a similar NNE strike to the gravity anomaly. Sampling of the ridge at three localities produced plagioclase-rich dacites and sandstones. The shape of the ridge and cataclastic textures (including slickensides) of some of the samples suggest that it is a fault sliver, whose top was eroded near sea level (as suggested by the presence of the coarse sandstones). These observations are consistent with the hypotheses that the Wishbone feature is a Cretaceous transform fault between the Osborn Trough spreading center and the Hikurangi Plateau.

A basaltic guyot on the easternmost end of the Chatham Rise has a planar top (presumably an erosional plateau) at 2,200 m water depth, and is located only 600 m above the sea floor to the south. Dacitic to granitic rocks with cataclastic textures were recovered on the easternmost Chatham Rise, and schists were recovered from a tilted fault block south of the eastern Chatham Rise. Guyots to the south of the eastern Chatham Rise are presently located at water depths of 2,000 - 3,400 m, indicating significant amounts of net subsidence of these volcanic structures. All samples from the guyots were basaltic, with plagioclase-porphyritic and/or intermediate lavas in the eastern Chatham Rise. The large net subsidence of the easternmost Chatham Rise and of seamounts to the south, evidence for faulting from multibeam mapping and the dredged samples, and the presence of continental type rocks (granites and schists) are consistent with the easternmost Chatham Rise being continental crust thinned during the Late Cretaceous break-up of Zealandia from Marie Byrd Land, Antarctica.

Bathymetric mapping and sampling of the Central and Western Chatham Rise revealed that volcanism primarily occurs in localised areas, such as around the Chatham Islands, Graveyard Seamount area, around Veryan Bank and at the Urry Knolls. Within these areas, volcanic cones and ridges are abundant and often densely clustered. No volcanic features were found outside of these areas. All recovered samples were basaltic, most commonly olivine porphyritic vesicular basalts.

Sediment Sampling

Soft sediment sampling with sediment tubes installed in the dredges yielded vital information about oceanographic features and will assist biological meiofauna investigations. The most common sediment obtained was foraminiferal sand (occurring from depths of 300 to 2,000 m) and ooze (1,600 – 4,000 m), the latter grading into sediment rich in siliceous sponge spicules (4,100 – 5,600 m), supporting evidence for a lysocline at ~3,500 m and a carbonate compensation depth at 4,700 m. Diversity of benthic foraminifera was highest at stations northwest of and along the crest of the Chatham Rise, reflecting areas of high nutrient supply.

Fossil phosphorites and carbonates were encountered on the Hikurangi Plateau and the Chatham Rise, respectively. The phosphorites were presumably formed during a widespread event of non-deposition in the Lower Miocene, whereas most of the limestones are Pliocene and Pleistocene in age. These consist of bryozoan and molluscan bioclasts, typical of a temperate water faunal association, and are rather weakly cemented.

Biology

Biological material was obtained successfully as macrofauna and as sediment samples containing meiofaunal organisms both on Hikurangi Plateau and Chatham Rise. The diversity and number of organisms recovered from a sample station increased rapidly with decreasing depth of sample location especially on Chatham Rise. Here, sessile animals such as corals and deteriorating rock surfaces offered a highly structured enviroment which was greatly appreciated by vagile organisms like Polychaeta, Echimodermata, and Crustacea. During the cruise, representatives of the Porifera, Actinaria, Scleractinia, Hydrozoa, Nemertini, Polychaeta, Echiura, Sipuncula, Bivalvia, Gastropoda, Crinoida, Holothuroida, Asteroida, Echinoida, Ophiuroida, Brachiopoda, Bryozoa, Tunicata, and fish were found. More than 2.100 specimens of the meiofauna were sorted on board of RV “Sonne” already revealing species of Nematoda, Kinorhyncha, Loricifera, Annelida, Sipuncula, Bivalvia, Copepoda, Ostracoda, Amphipoda, Tanaidacea, Isopoda, Tardigrada, and probably Gastrotricha and Plathelminthes.

Deep Water Corals and Cnidarian Reefs

Occurrences of modern deep water scleractinian corals, stylasterid hydrocorals and isidid gorgonians obtained on SO 168 cruise are concentrated along the southern margin of the Chatham Rise. Two modern coral / stylasterid reefs of several kilometers lateral extent were discovered along the southeastern margin of the Chatham Rise at 500 - 800 m depth: while the occurrence east of Chatham Islands is predominantly formed by stylasterids, the large reef complex south of Chatham Islands consists of azooxanthellate scleractinian *Goniocorella* thickets with associated solitary corals. In both cases, dredge hauls provided evidence of a vertical succession from cnidarian rubble to a zone of dead specimens with well preserved skeletons to eventually living reef communities on top. In addition, a patch reef of isidid gorgonian octocorals with soft coral overgrowths was detected on the southwestern margin of Chatham Rise at 600 - 800 m depth. The cnidarian reefs are tied to cool-temperate nutrient-rich water masses of high

hydrodynamic energy; unambiguous evidence of hydrocarbon seeps as possible nutritional base of those ecosystems was not observed on the cruise.

Fossil, manganese-encrusted deep-water corals of probably Pleistocene age were found on several seamounts of the southern Hikurangi Plateau. These scattered coral communities are predominantly composed of scleractinian *Madrepora* colonies showing a close association of non-symbiotic and symbiotic forms with commensal polychaetes. Age dating and stable isotope analysis of the coral skeletons will help to unravel the oceanographic history of the Hikurangi/Chatham Rise area and the reef evolution through Quaternary time.

Zusammenfassung

Die RV “Sonne”-Ausfahrt SO 168 ZEALANDIA begann offiziell am 3. Dezember 2002 in Wellington (Neuseeland) und endete am 16. Januar 2003 in Lyttelton/Christchurch (Neuseeland). Zwischen dem 3. und 16. Dezember fuhr die RV “Sonne” im Rahmen der Veranstaltungen des Bundesministeriums für Bildung und Forschung zum Jahr der Geowissenschaften 2002 nach Sydney. Das wissenschaftliche Programm von SO 168 wurde zwischen dem 15. Dezember 2002 und dem 14. Januar 2003 durchgeführt und umfasste Kartierungen und Beprobungen im Bereich des Challenger- und Hikurangipateaus, des Chatham Rise sowie des Ozeanbodens im Norden des Hikurangi Plateaus und im Norden und Süden des östlichen Chatham Rise.

Bathymetrische Kartierungen und Hartgesteinbeprobung

Im Bereich des gesamten Hikurangiplateaus wurden vor SO 168 lediglich bei einem einzigen Dredgezug Laven und vulkaniklastische Gesteine gewonnen. Überhaupt keine Proben existierten bisher aus dem östlichen Drittel des Chatham Rise oder von der an das Hikurangiplateau und den Chatham Rise grenzenden Ozeankruste. Auf der Ausfahrt SO 168 konnten Proben aus allen diesen Gebieten gewonnen werden. Von insgesamt 95 Dredgezügen, 6 TV-Greifer- und 4 Kastengreifereinsätzen erbrachten 77 der Geräteinsätze magmatische, metamorphe oder sedimentäre Gesteine (ohne Dropstones), 48 Mn-Fe-Oxide, 62 unverfestigte Sedimente und 73 biologisches Material.

Mit der erfolgreichen Gesteinsbeprobung hat die Ausfahrt SO 168 ihre Hauptziele erreicht, d.h. die detaillierte Beprobung (1) des Hikurangiplateaus einschliesslich seiner Basis und von Seamounts auf dem Plateau, (2) vulkanischer Gesteine, die mit der Abtrennung des östlichen Teils des neuseeländischen Mikrokontinents Zealandia von der Antarktis assoziiert sind und (3) kretazische bis neogene Intraplattenvulkanite entlang des gesamten Chatham Rise. Die Beprobung des Hikurangiplateaus ist wahrscheinlich die bis heute umfassenste (marine) Beprobung einer „Large Igneous Province“. Weiterhin wurden Seamounts auf der an das Hikurangiplateau grenzenden ozeanischen Kruste beprobt.

Die Ergebnisse der bathymetrischen Kartierungen mit dem Fächerecholot SIMRAD und der Gesteinsbeprobung erlauben einige vorläufige Schlussfolgerungen zum Ursprung und zur Entwicklung des Hikurangiplateaus und des kretazischen und neogenen Vulkanismus am Nordostrand von Zealandia. Die vulkanischen Proben vom Hikurangiplateau sind basaltisch, wobei am Basement des Plateaus (am Rapuhia Scarp) ausschließlich äquigranulare, fein- bis grobkörnige Laven und an den Seamounts auf dem Plateau stets olivin-porphyrische, blasige Basalte gedredged wurden. Die Seamounts auf dem Plateau lassen sich in 2 unterschiedliche Gruppen einteilen. Im inneren Teil des Plateaus dominieren Guyot-ähnliche Seamounts, die durch steile Flanken und ein gr0ßes Plateau im Topbereich gekennzeichnet sind. Solche Vulkane werden als ehemalige Inselvulkane angesehen, die nach dem Abklingen der vulkanischen Aktivität bis zum Meeresspiegel erodiert wurden. Diese Hypothese wird auch durch die Art und Struktur der dort gefundenen vulkanischen Gesteine gestützt, die auf Eruptionen im Flachwasser oder an Land hindeutet. Die Erosionsplattformen liegen stets ca. 1.050 m über dem Ozeanboden, was auf ein ähnliches Alter für alle diese Seamounts hindeutet. Wenn man von etwa 400 m Sedimentmächtigkeit ausgegeht (worauf seismische Profile hindeuten), so hat sich das Hikurangiplateau zum Zeitpunkt der Erosion der Seamounts in etwa 1.500 m Wassertiefe befunden. Die Wassertiefe, in der sich die Erosionsplattformen (1.600 - 3.300 m) und die Basis der Seamounts (2.700 - 4.200 m) heute befinden, nimmt zum Nordrand des Plateaus hin systematisch zu. Dies deutet darauf hin, dass das gesamte Hikurangiplateau nach der Erosion der Seamounts bzw. Inselvulkane erheblich abgesunken und nach Norden gekippt ist. Die zweite Gruppe von Seamounts sind vulkanische Rücken, die sich direkt am Nordostrand des Hikurangiplateaus bzw. bis zu 70 km von diesem entfernt auf dem Plateau befinden und deren Längsachse stets generell subparallel zum Plateaurand verläuft. Wahrscheinlich haben sich diese Rückenstrukturen entlang von Störungszonen gebildet. Die Kartierung am Rapuhia Scarp zeigte, dass dieser aus mehreren verkippten

Blöcken besteht und nicht nur eine einzelne Störung repräsentiert. Insgesamt deuten die stärkere Absenkung des nordwestlichen Randbereichs des Hikurangiplateaus, die multiplen, zur Plateaukante subparallel verlaufenden Störungszonen und die daran gebundenen Vulkanrücken auf Rifting und riftbezogenen Vulkanismus hin. Diese Beobachtung unterstützt die Hypothese, dass das Hikurangiplateau und das etwa 20° weiter im Norden gelegene Manihikiplateau einst verbunden waren und später auseinandergebrochen sind, wobei neuer Ozeanboden am dem Paläo-Spreizungszentrum Osbourn Trough,, das heute auf halben Weg zwischen beiden Plateaus liegt, gebildet wurde.

Der im Nordosten des Hikurangiplateaus gelegene Wishbonerücken bildet auf Gravimetriekarten als 1.300 km lange, gabelförmige negative Schwereanomalie. Im südlichen Teil des Wishbonerückens wurde auf SO 168 eine 53 km lange Rückenstruktur mit steilen Flanken, flachem Top und ähnlicher Ausrichtung wie die Schwereanomalie kartiert und beprobt. Die Dredgezüge an dieser Struktur erbrachten plagioklasreiche Dacite und Sandsteine. Die Form des Rückens, kataklastische Texturen (z.B. Harnische) an einigen Proben und grobkörnige Sandsteine deuten darauf hin, dass dieser Rücken ein Bruchstück in einem Störungssystem ist, und dass sein oberer Teil am Meersspiegel erodiert wurde. Diese Beobachtung spricht für das Modell, dass der Wishbonerücken eine kretazische Transformstörung zwischen dem Osbourne Trough und dem Hikurangi Plateau ist.

Ein basaltischer Guyot, der sich am östlichsten Ende des Chatham Rise befindet, hat einen abgeflachten Topbereich in 2200 m Wassertiefe, bei dem es sich wahrscheinlich um ein durch Erosion an der Wasseroberfläche entstandenes Plateau handelt. Ebenfalls am Ostende des Chatham Rise wurden dazitische bis granitische Gesteine mit kataklastischen Texturen gedredged und an einem verkippten, von Störungen begrenzten Block im Süden des östlichen Chatham Rise auch Schiefer. Die auf SO 168 kartierten Guyots im Süden des östlichen Chatham Rise befinden sich heute in 2.000 bis 3.400 m Wassertiefe. Demnach sind auch diese Vulkane stark abgesunken. Alle Proben von den Guyots sind basaltisch, wobei am östlichen Chatham Rise plagioklas-porphyrische Laven dominieren. Die starke Absenkung des Ostende des Chatham Rise und der südlich davon gelegenen Seamounts, Hinweise auf Störungen in den mit SIMRAD erstellten Karten und an den gedredgeden Proben sowie das Vorhandensein kontinentaler Gesteinstypen (Granite und Schiefer) deuten darauf hin, dass das Ostende des Chatham Rise aus kontinentaler Kruste besteht, die während der Abtrennung Zealandias von Marie Byrd-Land (Antarktis) in der Spätkreide ausgedünnt wurde.

Bathymetrische Kartierungen und die Beprobung im Bereich des zentralen und östlichen Chatham Rise zeigten, dass Vulkanismus hier nur in lokal begrenzten Gebieten auftritt, wie z.B. bei den Chathaminseln, an den Graveyard Seamounts, bei der Veryan Bank und in Bereich der Urry Knolls. Innerhalb dieser Gebiete sind vulkanische Kegel und Rücken jedoch häufig und bilden oft größere Vulkanfelder. Ausserhalb dieser Gebiete wurden keinerlei Anzeichen für Vulkanismus gefunden. Alle in diesen Gebieten gewonnen Proben sind basaltisch, wobei blasige Olivinbasalte überwiegen.

Sedimentbeprobung

Die Beprobung von unverfestigten Sedimenten mit den in den Dredgen installierten Sedimentfallen lieferte wichtige ozeanographische Informationen und ist für die Untersuchungen der Meiofauna bedeutend. Das häufigste Sediment war Foraminiferensand, der in Wassertiefen von 300 bis 2.000 m auftrat, und Foraminiferenschlamm (1.600 - 4.000 m), der in größeren Wassertiefen in Sedimente mit zahlreichen Schwammnadeln (4.000 - 5.600 m) übergeht. Die Tiefenverteilung der Sedimente deutet darauf hin, dass die Lysokline hier bei ca. 3.500 m Wassertiefe und die CCD (“carbonate compensation depth ”) bei 4.700 m liegt. Die Diversität der benthischen Foraminiferen ist im Nordwesten des Chatham Rise und auf seinem Kamm am höchsten, was eine starke Zufuhr von Nährstoffen in diesem Gebieten reflektiert.

Fossile Phosphorite und Karbonate wurden auf dem Hikurangiplateau und auf dem Chatham Rise gefunden. Die Phosphorite wurden vermutlich im Unteren Miozän während eines Zeitraumes, in dem keine Sedimente abgelagert wurden, gebildet Die Kalksteine haben hingegen Pliozäne und Pleistozäne Alter, bestehen aus Bryozoen- und Mollusken-Bioklasten (eine typische Faunenassoziation für gemässigte Gewässer) und sind nur zeimlich schwach zementiert.

Biologie

An biologischen Material konnten sowohl auf dem Hikurangiplateau als auch im Gebiet des Chatham Rise zahlreiche Organismen der Makrofauna sowie Sedimente, die Meiofauna beinhalteten, beprobt werden. Die Diversität und Anzahl der Organismen der Makrofauna an den Stationen nimmt

insbesondere am Chatham Rise mit abnehmender Wassertiefe signifikant zu. Sessile Tiere wie Korallen und rauhe Gesteinsoberflächen bieten dort einen stark strukturierten Lebensraum, der bevorzugt von vagilen Organismen wie Polychaeta, Echimodermata und Crustacea besiedelt wird. Ausserdem wurden während der Ausfahrt Exemplare der Porifera, Actinaria, Scleractinia, Hydrozoa, Nemertini, Polychaeta, Echiura, Sipuncula, Bivalvia, Gastropoda, Crinoida, Holothuroida, Asteroida, Echinoida, Ophiuroida, Brachiopoda, Bryozoa, Tunicata und Fischen gefunden. Weiterhin wurden mehr als 2100 Tiere der Meiofauna bereits an Bord von RV ”Sonne“ sortiert und als Imdividuen der Nematoda, Kinorhyncha, Loricifera, Annelida, Sipuncula, Bivalvia, Copepoda, Ostracoda, Amphipoda, Tanaidacea, Isopoda, Tardigrada und wahrscheinlich Gastrotricha und Plathelminthes bestimmt.

Tiefwasserkorallen

Während der RV “Sonne”-Ausfahrt SO 168 ZEALANDIA wurden rezente scleractinide Tiefwasserkorallen, stylasteride Hydrokorallen und isidide Gorgonien entdeckt, wobei größere Vorkommen am Südrand des Chatham Rise konzentriert sind. Mehrere Dredgezüge am Südostrand des Chatham Rise in 500 - 800 m Wassertiefe liefern Hinweise auf zwei rezente Korallen/Stylasteriden-Riffe von mehreren Kilometern Längserstreckung. Während das Vorkommen östlich der Chathaminseln überwiegend aus Stylasteriden aufgebaut ist, besteht der große Komplex südlich der Chathaminseln aus azooxanthellaten scleractiniden *Goniocorella*-Dickichten mit assoziierten Einzelkorallen. In beiden Fällen ist eine vertikale Abfolge aus Korallenschutt an der Basis, einer darüber folgenden Zone aus toten Exemplaren mit gut erhaltenen Skeletten sowie lebenden Riffgemeinschaften am Top zu erkennen. Ferner wurde am Südwestrand des Chatham Rise in 600 - 800 m Tiefe ein Patch-riff aus isididen Gorgonien (Octokorallen) ausfindig gemacht, welche intensiv von Weichkorallen überwachsen sind. Diese Riffvorkommen sind an kühl-gemäßigte, nährstoffreiche Wassermassen mit hoher hydrodynamischer Energie gebunden; eindeutige Hinweise auf Kohlenwasserstoff-Austritte am Meeresboden als mögliche Nährstoffbasis dieser Ökosysteme wurden auf der Cruise nicht beobachtet.

Fossile, mangan-verkrustete Tiefwasserkorallen wahrscheinlich pleistozänen Alters wurden auf mehreren Seamounts des südlichen Hikurangi-Plateaus entdeckt. Diese verstreut auftretenden Korallengemeinschaften werden von scleractiniden *Madrepora*-Kolonien dominiert, in denen asymbiontische Exemplare und symbiontisch mit kommensalen Polychaeten lebenden Formen eng miteinander assoziiert sind. Mit Hilfe radiogener Altersdatierungen und stabiler Isotopenanalysen der Korallenskelette werden die ozeanographische Geschichte des Hikurangi/Chatham Rise-Gebietes und die Riffentwicklung im Laufe des Quartärs rekonstruiert.

2. ACKNOWLEDGEMENTS

We would especially like to thank Captain Kull and the crew of the RV „Sonne“. Their hard work, high level of experience, willingness to help, and the pleasant working atmosphere on board contributed directly to the success of the SO 168 cruise. We are very grateful to Bryan Davy and Rick Herzer, New Zealand Institute of Geological & Nuclear Sciences (GNS), for generously providing a variety of reprints, maps, seismic lines and other invaluable information. Without their assistance, dredge site targets would have been much more time consuming to locate and the cruise would not have so thoroughly achieved its objectives. We would also like to acknowledge the past contributions of Chris Carey and Adrian Douglas (officers on Nelson trawlers in the early 1990s) who supplied GNS with what, until this cruise, was the largest single collection of dredged rocks in the SO 168 work area. We thank the Government of New Zealand for granting permission to work within their territorial waters. The National Institute of Water and Atmospheric Research is thanked for permission to collect biological samples.

The ZEALANDIA project is funded by Bundesministerium für Bildung und Forschung (BMBF) project award to Prof. Kaj Hoernle, Dr. Paul van den Bogaard and Dr. Folkmar Hauff. Nick Mortimer’s funding was provided by the New Zealand Foundation for Research Science and Technology.

3. PARTICIPANTS

3.1. Ship's Crew

Kull, Martin	Master		
Göldner, Frank-Rüdiger	1st Officer	Hartwig, Volker	Chief Engin.
Löffler, Jörn	1st Officer	Lindhorst, Norman-Clemens	2nd Engineer
Naht, Dietrich	1st Officer	Schade, Uwe	2nd Engineer
Stammer, Kurt	Chief Electr. Engineer	Papendieck, Rainer	Electrician
Wentzel, Heinz	Electronic Engineer	Szych, Uwe	Motorman
Großmann, Matthias	Systems Manager	Lange, Gerhard	Motorman
Tormann, Martin	Systems Manager	Voss, Thomas	Motorman
Schlenker, Wilhelm	Surgeon	Zelk, Hartmut	Motorman
Tiemann, Frank	Chief Cook	Rosemeyer, Rainer	Fitter
Braatz, Willy	2nd Cook	Slotta, Werner	Chief Steward
Baron, Heiko	Boatswain	Baumgärtel, Anja	2nd Steward
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Hödl, Werner	A.B.	Ventz, Günter	A.B.
Bosselmann, Norbert	A.B.	Milhahn, Christian	Apprentice
Schrapel, Andreas	A.B.	Walderstein, Manfred	Apprentice

3.2. Principal Investigators for ZEALANDIA

Hoernle, Kaj	GEOMAR
Bogaard, Paul van den	GEOMAR
Hauff, Folkmar	GEOMAR

3.3. Scientific Cooperators *(in alphabetical order)*

Davy, Bryan	GNS (NZ)
Dullo, Christian	GEOMAR (GER)
Eisenhauer, Anton	GEOMAR (GER)
Gohl, Karsten	AWI (GER)
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Herzer, Richard	GNS (NZ)
Lüter, Carsten	HUB (GER)
Mortimer, Nicholas	GNS (NZ)
Neuhaus, Birger	HUB (GER)
Reilly, Sue	MU (AUS)
Stoffers, Peter	CAU (GER)
Werner, Reinhard	TETHYS (GER)
White, James	UO (NZ)

3.4. Shipboard Scientific Party *(in alphabetical order)*

Berning, Björn	Sedimentology/Biology	UHH
Bornstedt, Juliane	Petrology/Sedimentology	EMAU
Hauff, Folkmar	Geochemistry	GEOMAR
Hoernle, Kaj (Chief Scientist)	Geochemistry	GEOMAR
Hoffmann, Jana	Biology	HUB
Krolikowska, Sylwia	Geochemistry	GEOMAR
Kropf, Andreas	Petrology/Sedimentology	EMAU
Lüter, Carsten	Biology	HUB
Möller, Arnulf	Bathymetry	i.A.v. GEOMAR
Mortimer, Nicholas	Petrology/regional Geology	GNS
Noé, Sibylle	Deep Water Corals	TETHYS
Neuhaus, Birger	Biology	HUB
Rabehl, Simone	Petrology/Sedimentology	EMAU
Rehder, Miriam	Geochemistry	GEOMAR
Stottmeister, Iris	Petrology/Sedimentology	EMAU
Vetter, Silke	Geochemistry	i.A.v. GEOMAR
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Zahn, Sigurd	Petrology	i.A.v. GEOMAR

3.5. Institutions

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GEMOC Macquarie University, National Key Centre for Geochemical Evolution and Metallogeny of Continents (GEMOC), Department of Earth and Planetary Sciences, NSW 2109, Australia (http://www.es.mq.edu.au/GEMOC)

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UHH University of Hamburg, Institute of Geology/Paleontology, Bundesstr. 55, 20146 Hamburg, Germany (http://www.geowiss.uni-hamburg.de)

UO University of Otago, Geology Department, PO Box 56, Dunedin 9015, New Zealand (http://www.otago.ac.nz)

4. INTRODUCTION TO THE ZEALANDIA PROJECT

The ZEALANDIA research project should contribute to a better understanding of causes and effects of magmatic processes in the Southwest Pacific east of New Zealand which is characterized by intraplate volcanism and continental rifting. The major goals of these investigations are to contribute to a better understanding of the origin of volcanic oceanic plateaus (or Large Igneous Provinces = LIPs), associated mantle processes, the relationship between LIPs and continental break-up, and to the reconstruction of the plate tectonic evolution of the southwest Pacific. Furthermore, ZEALANDIA should provide new informations on maganese crusts and deep sea organisms in this area. Insights into the geological and biological processes in the region east of New Zealand are also relevant to issues of environmental protection, habitat preservation, maritime law convention (extent of the continental shelves) and risk assessment (volcanism, earthquakes and climate change). During the RV “Sonne” cruise 168, detailed geological and biological sampling, as well as bathymetric mapping, of the ocean floor has been conducted east of New Zealand. In contrast to “normal” oceanic floor, the structure and morphology in this area is highly complex and forms part of the vast submarine micro-continent “Zealandia” of which the islands of New Zealand only form a small part (approximately 15%) (Fig. 4.1.). The eastern portion of Zealandia is dominated by the shallow submarine Campbell Plateau, Bounty Trough and Chatham Rise to the southeast and east of the South Island of New Zealand. The Hikurangi Plateau occurs on the edge of Zealandia and is located off the North Island of New Zealand (Fig. 4.1.).

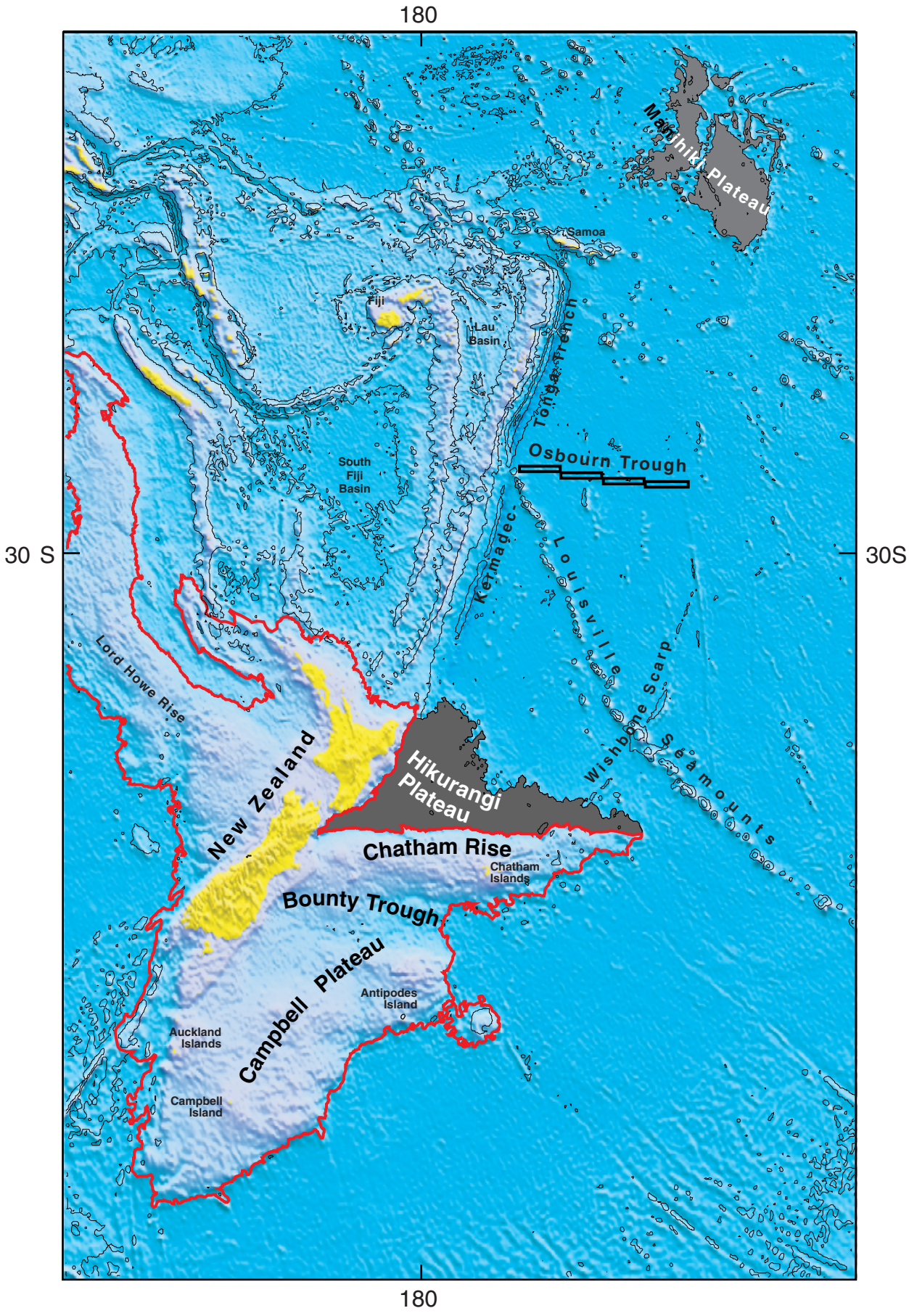

Fig. 4.1.: Bathymetric map of the Southwest Pacific shows the micro-continent "Zealandia" (marked by the thick red line) and the Hikurangi nad Manihiki LIP´s (dark grey areas). Bathymetry is based on the TOPEX dataset published by Smith and Sandwell (1997).

The Hikurangi Plateau or Large Igneous Province (LIP) covers 350,000 square kilometers and consists primarily of volcanic rocks. This plateau is believed to have formed through a massive mushroom-shaped upwelling of the Earth's mantle, associated with the initial stage of *a mantle plume*. The Campbell Plateau and the Chatham Rise consist of continental crust that were attached to Marie Byrd Land (Antarctica) before 110 million years ago forming part of the Gondwana supercontinent. Before 130 million years ago, Gondwanaland was a single giant southern continent consisting of Zealandia, Antarctica, Australia, India, Africa and South America. The break-up of this supercontinent began with the separation of Africa and South America, beginning ca. 130 million years ago. The separation of Zealandia and Australia from Antarctica at ca. 105 million years ago represents the final phase of the breakup of Gondwanaland into the present-day continents. The mushroom-shaped plume head, believed to be responsible for the formation of the Hikurangi Volcanic Plateau, may also have caused Zealandia and Australia to break away from Antarctica, drifting to their present locations over the last ca. 100 million years. The chemistry and age of volcanic rocks from the Hikurangi Plateau and the margins of Zealandia are necessary to determine the role of a mantle plume head in the final breakup of Gondwanaland. Volcanism on the Campbell Plateau, Chatham Rise and Bounty Trough continued over the last 100 million years. Its widespread and long-lived nature are enigmatic.

The sampling on SO 168 yielded an extensive collection of marine animals, corals, manganese/iron crusts and nodules, and volcanic, plutonic, sedimentary and metamorphic rocks from the Zealandia crust. Further rock sampling on the Campbell Plateau has been carried out on RV "Sonne" cruise SO 169 (Dr. Gohl, AWI). Magmatic rocks sampled by the RV "Sonne" from the ocean floor will be analyzed with different methods in several geochemical laboratories. The ages of whole rocks, volcanic glasses and minerals will be determined by $^{40}Ar/^{39}Ar$ dating. Major element geochemistry will constrain magma chamber processes within the crust, and also yield information on the average depth of melting, temperature and source composition to a first approximation. Further analytical effort will concentrate on methods that constrain deep seated mantle processes. For example, trace element data help to define the degree of mantle melting and help to characterize the chemical composition of the source. Radiogenic isotopic ratios such as $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$ and $^{176}Hf/^{177}Hf$ are independent of the melting process and reflect the long term evolution of a source region and thus serve as tracers to identify mantle and recycled crust sources. $^{3}He/^{4}He$-isotopic ratios trace the depth from which the mantle material originates. Elevated ^{3}He-sigantures are commonly thought to reflect an origin from the less degassed lower mantle. Through integration of these various geochemical

parameters and the age data the origin and evolution of the different sampled structures can be reconstructed.

The origin of the Hikurangi Plateau will be investigated with this approach. The most important question is if (1) the Hikurangi Plateau was a portion of the Manihiki LIP and has been seperated from it by sea floor spreading at the Osbourn Trough (Fig. 4.1.) and if (2) the formation of this LIP is associated with the break-up of Gondwana and the formation of the Pacific-Antarctic Ridge. Further informations on the role of a possible plume (or a rising plume head) in this process should be achieved by the investigation of the rift-related magmatism at the northeast edge of the Campbell Plateau and in the borderland between Chatham Rise and Bounty Trough. These studies should provide new informations on the role of mantle plumes in initiation of continental rifting and sea floor spreading and, therefore, in the formation of oceanic basins.

On the other hand the magma sources of volcanic rocks in the area of the Campbell Plateau and the Chatham Rise should be characterized to constrain the origin of the Cenozoic volcanism on the New Zealandic microcontinent. Major questions are: Do the Cenozoic intraplate volcanic rocks have a similar composition (or component) as the Hikurangi rocks or as Cenozoic volcanic rocks in Marie Byrd Land and Northern Victoria (Antarctica), which are believed to be derived from lithospheric sources and thus a fossil plume head? Is this component located in the lithosphere? Such data can provide important constraints on the presence of a fossil plume head beneath the New Zealand continent, supporting a role for a plume head in the separation of New Zealand from Antarctica

The analysis of the biological samples gained on SO 168 will concentrate on the key groups Kinorhyncha, Loricifera (corset animals), Copepoda, Brachiopoda (lamp shells), Bryozoa (moss animals), Tardigrada (bear animals), Amphipoda, Porifera (sponges), and Polychaeta (bristle worms). The deep-sea faunal communities will be investigated in order (1) to define more clearly the distribution of organisms in the deep-sea environment, (2) to elucidate the potential influence of geomorphological structures like the Chatham Rise on the distribution of the fauna, and (3) to test the hypothesis about the potential different geological origin of the Hikurangi Plateau and the micro-continent Zealandia (comp. geological studies during SO 168) by comparing the fauna on Hikurangi Platea and the fauna on Campbell Plateau. Additionally, any biological material recovered with or growing on the rock samples was preserved and will be made accessible to the scientific community.

In summary, the main objectives of ZEALANDIA are:

- A better understanding of the origin of Large Igneous Province (LIPs), associated mantle processes, the relationship between LIPs and continental break-up and the onset of sea floor spreading should be achieved by geochemical and age data from the Hikurangi Plateau or

LIP, as well as from mid Cretaceous rift-related magmatism from the Bounty Trough, Chatham Rise and Campbell Plateau. An important question here is if the formation of this LIP was related to the break-up of the supercontinent Gondwana or if it even triggered this plate tectonic event.

- The origin of Cenozoic intraplate magmatism should be evaluated based on age and geochemical data from on the Chatham Rise and Campbell Plateau. We will attempt to determine if it originates from the upwelling of shallow asthenosphere or from a swarm of weak, episodic plumes beneath New Zealand. In addition, we will use the Cenozoic volcanism to evaluate the hypothesis that a fossil plume head is located beneath the New Zealand continent.
- Investigations of manganese/iron crusts and nodules recovered during the research expedition are of special interest for geology, mineralogy, climatology and submarine mining. They can contain high contents of tungsten, cadmium and other rare metals and elements. Because of their very slow growth rates they also represent a unique archive for the reconstruction of the chemistry of seawater in the past.
- The main biological objectives concern the geographical distribution of deep-sea life forms, their habitats and their genetic relationships in the southwest Pacific. These studies will contribute data for monitoring, coastal management, and sustainable development of New Zealand marine animals.
- Deep water corals from the continental slope of New Zealand will be studied to reconstruct environmental parameters in this area such as past water temperatures, and to evaluate the potential of these species-rich ecosystems for marine raw material research.

5. CRUISE NARRATIVE

The SO 168 cruise of the ZEALANDIA project funded by the German Ministry of Education and Research (BMBF) officially started on Dec. 3 in Wellington, New Zealand. The RV “Sonne” then proceeded on its transit to Sydney to carry out activities in the framework of the GEO Year 2002, which was sponsored by the BMBF. No scientific work was planned or carried out on the transit from Wellington to Sydney. The RV “Sonne” arrived in Sydney on Sunday December 8 and docked at the Circular Quay in downtown Sydney directly across from the scenic Opera House. On Monday December 9, the RV “Sonne” was open to the public from 10:00 a.m. to 3:00 p.m. and received approximately 300 visitors. A press conference, held at 11:30 a.m. on the RV “Sonne”, provided information about the ship, German marine research, and the SO 167-9 cruises. In the evening, a reception was held on board for Australian, New Zealand, and German scientists and government officials. The following day the RV “Sonne” underwent preparations for the Zealandia SO 168 cruise and the SO 168 scientists boarded the ship.

At 9:00 o’clock on the morning of December 11, the RV “Sonne” departed Sydney. On the evening of December 15, we reached Mt. Spong on the Challenger Plateau just over 200 nautical miles west of the South Island of New Zealand (Fig. 5.1.). Two dredges were successfully carried out on the inner western wall of the crater of this small volcano. On December 16, the RV “Sonne” passed through the Cook Strait between the North and South Island of New Zealand allowing scenic views of the mountains on both islands, such as the snow-covered Tapuaenuku peak. The trace of the Alpine fault, the boundary between the Pacific and Australian Plates, was also clearly discernible from the ship.

On December 17, we reached the Graveyard Seamount group on the central northern flank of the Chatham Rise, which is made of thinned continental crust. There volcanic and biologic samples were recovered from Graveyard, Morgue and Headstone seamounts.

From the Graveyard Seamounts on the Chatham Rise, the RV “Sonne” proceeded north to the Hikurangi Plateau (Fig. 5.1.). Nine large seamounts with heights of 1,000 - 1,600 m above the sea floor were mapped and dredged on a transect from the southern to the northern edge of the western Hikurangi plateau. Volcanic samples were obtained from eight of the seamounts. Manganese-iron (Mn-Fe) crusts and nodules, sediments and biologic material were obtained from most seamounts. Single volcanic cones and rift systems (reaching 20 km in length) were clearly recognizable in the swath bathymetry of the seamounts. The TV grab and box corer were used to sample sediments for biological studies on the ocean floor near one of the seamounts.

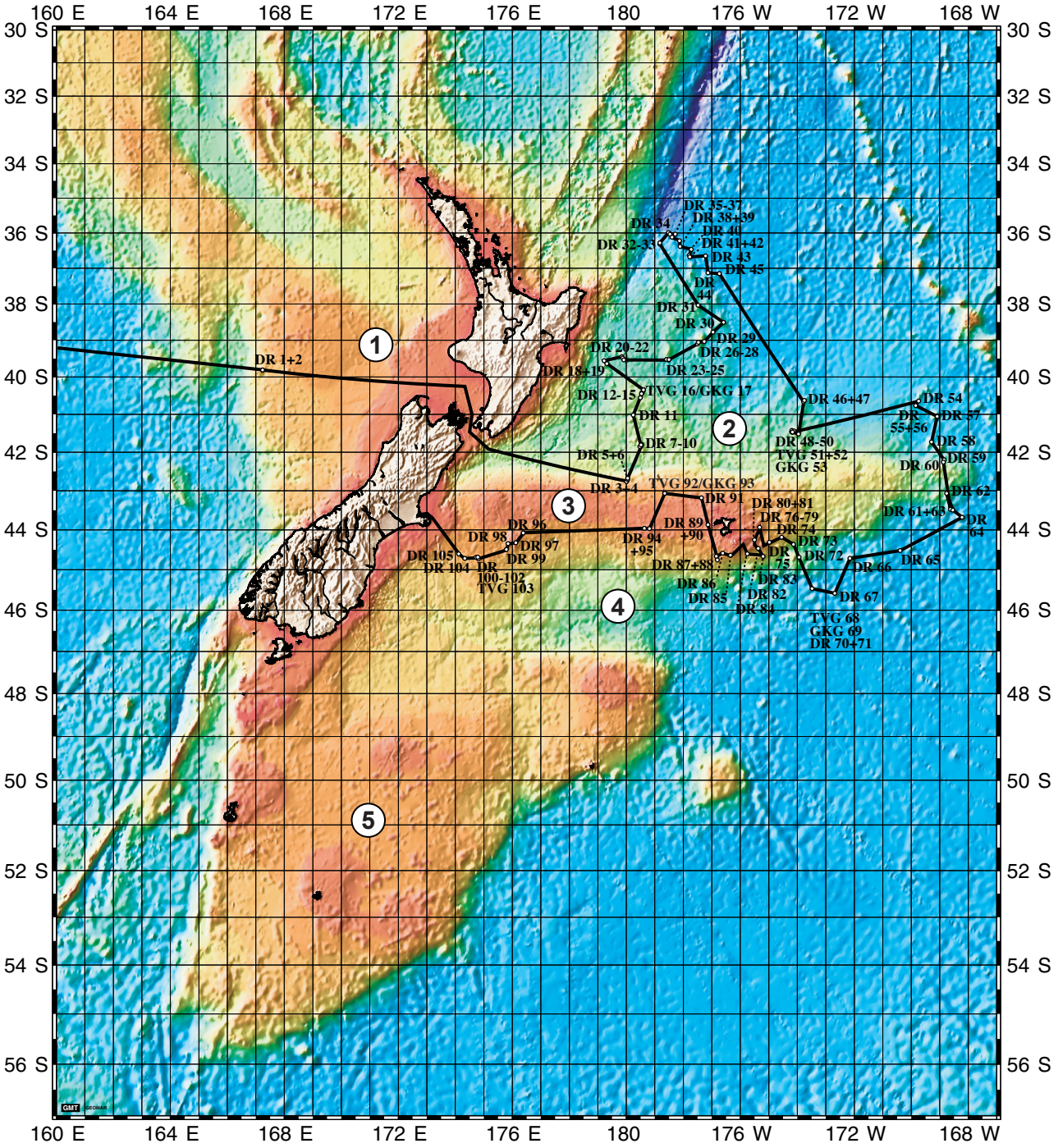

Fig. 5.1.: Ship track and stations for SO 168. Bathymetry is based on the TOPEX dataset published by Smith and Sandwell (1997).

DR: Chain bag dredge
TVG: TV grab
GKG: Giant box corer

1: Challenger Plateau
2: Hikurangi Plateau
3: Chatham Rise
4: Bounty Trough
5: Campbell Plateau

The crew and scientists celebrated Christmas Eve with a lively party at which Santa Claus and his angel made an appearance to distribute an impressive array of presents, many of which were hand made by the ship's crew. The next week was spent mapping and sampling the northwestern edge and the western part of the Hikurangi Plateau. The SIMRAD EM 120 multibeam sea floor mapping produced spectacular pictures of the up to one kilometer high Rapuhia fault scarp, which forms the northwestern boundary between the Hikurangi oceanic plateau and the deeper normal oceanic crust (abyssal plain) to the northeast. Volcanic and sedimentary rocks, Mn-Fe oxides and biological samples were recovered from six localities along the scarp, two ridge-like seamounts on the edge of the scarp and three seamounts on the adjacent ocean crust.

On December 29, the RV "Sonne" made the transit to the eastern Hikurangi Plateau. Volcanic samples and Mn-Fe oxides were successfully recovered from a ridge-like structure on the margin of the Hikurangi Plateau and a guyot in the interior of the Plateau. Sediments were recovered in the dredges from both localities and from the top of the guyot with the TV grab and box corer. Solitary fossil corals were obtained at depths in excess of 2,200 m. The scientists and crew welcomed the New Year together with a lively celebration.

After leaving the Hikurangi Plateau on New Years Eve, the RV "Sonne" proceeded to the Wishbone structure, a curvilinear gravity anomaly that has been interpreted as a Cretaceous transform fault extending from the Osborn Trough spreading center to the Hikurangi Plateau. A 53 km long, very steep-sided, flat-topped ridge with a similar NNE strike as the gravity anomaly was sampled, as well as two volcanic seamounts east and southeast of the Wishbone ridge. Then the RV "Sonne" crossed the easternmost end of the Chatham Rise sampling the rift arm of a guyot. Dacitic to granitic rocks were recovered from a fault scarp of a flat ridge.

SIMRAD EM 120 mapping of nine seamounts south of the eastern Chatham Rise revealed six guyots, a ridge-type volcanic structure and three tilted, fault-bounded blocks. Four guyots, the volcanic ridge and the one of the tilted blocks were sampled through dredging. Sediments on top of one of the guyots were sampled at a depth of 3,900 m with the TV grab.

On January 7, sampling began on the Chatham Rise near the Chatham Islands (Fig. 5.1.). Numerous volcanic cones and ridges, many occurring in clusters, were mapped and sampled over the course of the next three days, bringing abundant rock and biological samples, including corals, on board. Many dredge stations afforded nice views of the Chatham Islands. Clams brought up in the dredge were prepared by the cooks one evening as an appetizer. On January 10, a dredge became stuck at 80 m water depth and was lost.

On January 11, the RV "Sonne" proceeded westwards on the Chatham Rise searching for a 16 m coral mound reported in the literature. Despite looking with the TV grab, the coral mound was not found, nor were any volcanic structures. Sediment samples were taken with the TV grab

and box corer. The end-of-the cruise party was held that evening and included a barbecue on deck followed by dancing in the seismic laboratory. It was a beautiful evening: warm and sunny with calm seas.

On January 12, we arrived at Matheson Bank where volcanic rocks had been reported in the Chatham Rise Monograph but none were found. On January 13 and 14, numerous volcanic cones and ridges, often occurring in clusters as they did near the Chatham Islands, were sampled near Veryan Bank and the Urry Knolls southeast of the Banks Peninsula. On January 15, we met the Lyttelton Harbor pilot at 8 a.m. and docked shortly thereafter (Fig. 5.1.). The scientists spent January 15 packing and cleaning up the laboratories and disembarked at 11:00 a.m. on January 16.

6. BATHYMETRY AND ROCK SAMPLING

This section gives background information and short summaries of the features sampled through dredging and/or mapped with the SIMRAD EM 120 multi-beam echo-sounding system.

Only a few seamounts have been named by earlier surveys (e.g., Mt. Spong, Graveyard Seamounts, Katz Seamount). SO 168 assigned informal working names to un-named seamounts and ridges in different areas, based on past New Zealand Prime Ministers, native New Zealand fauna, German cities and the crew of Cpt. Cook's *Endeavour* voyage of 1768 - 1770 (Fig. 6.1.). Refer to Appendix I - III for latitude, longitude and depth of dredge sites and a summary of rock descriptions. Refer to figures 6.2. - 6.48. for bathymetric maps of the dredge sites (seamounts, ridge-like structures and scarps) generated by the SIMRAD EM 120 swath mapping system onboard SO 168. Distances between seamounts are given between the seamount tops and are approximate only; dimensions and heights are preliminary and are included only to give a rough idea of seamount dimensions.

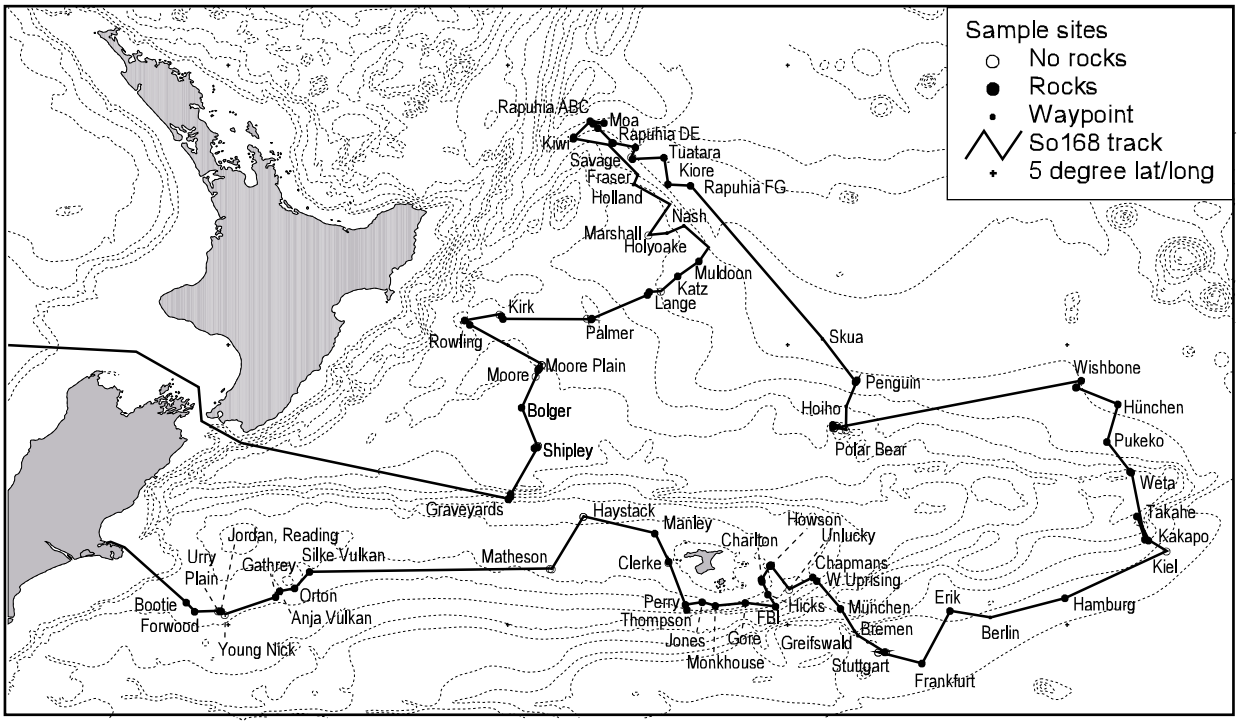

Fig. 6.1.: Overview map showing SO 168 sampling sites. Most names are informal working names assigned on SO 168. Stations DR 1 and 2 (Mount Spong) are off the map.

6.1. METHODS

6.1.1. Bathymetry

Data Acquisition

Since June 2001 the RV “Sonne” is equipped with the SIMRAD EM 120 multi-beam echo sounder (Kongsberg) for a continuous mapping of the seafloor. This system substitutes the former echo sounder HYDROSWEEP. The SIMRAD EM 120 echo sounder system consists of several units. A transmit and a receive transducer array is fixed in a mills cross below the keel of the vessel. A preamplifier unit contains the preamplifiers for the received signals. The transceiver unit contains the transmit and receive electronics and processors for beam-forming and control of all parameters with respect to gain, ping rate and transmit angles. It has serial interfaces for vessel motion sensors, such as roll, pitch and heave, external clock and vessel position. Furthermore the system contains a SUN-workstation as an operator station. The operator station processes the collected data, applying all corrections, displays the results and logs the data to internal or external disks. The EM 120 system has an interface to a sound speed sensor.

SIMRAD EM 120 uses a frequency of about 12 KHz with a whole angular coverage sector of up to 150° (75° per port-/starbord side). If one ping is sent the receiving signal is formed into 191 beams by the transducer unit through the hydrophones in the receiver unit. The beam spacing can be defined in an equidistant or equiangular distance, or in a mix of both of them. The ping-rate depends on the water depth and the runtime of the signal through the water column. The variation of angular coverage sector and beam pointing angles was set automatically. This optimized the number of usable beams.

During the survey the transmit fan is split into individual sectors with independent active steering according to vessel roll, pitch and yaw. This forces all soundings on a line perpendicular to the survey line and enables a continuous sampling with a complete coverage. Pitch and roll movements within ±10 degrees are automatically compensated by the software. Thus, the SIMRAD EM 120 system can map the seafloor with a swath width about up to six times the water depth. The geometric resolution depends on the water depth and the used angular coverage sector and is less than 10 m at depths of 2,000 - 3,000 m.

The accuracy of the depth data obtained from the system is usually critically dependent upon weather conditions and the use of a correct sound speed profile. During SO 168 four sound profiles have been recorded at different stations. Thus, the correct sound velocity was used in the different geographical areas on this cruise.

Data Processing

The collected data were processed onboard with the coverage software EM 120. The post-processing was done on two other workstations by the accessory software Neptune and Cfloor (Roxa, Smedvig Tech., Oslo). The Neptune software converted the raw data in 9 different files which contains informations about position, status, depth, sound velocity and other parameters and are stored in a SIMRAD own binary format.

The data cleaning procedure was accomplished by the Neptune software. The first step was to assign the correct navigational positions to the data without map projections. The second step was the depth corrections, for which a depth threshold was defined to eliminate erratic data points. In the third part of post-processing statistical corrections were applied. Therefore, a multitude of statistical functions are available in a so called BinStat window where the data are treated by calculating grid cells with an operator-choosen range in x and y direction. Each kind of treatment is stored as rule and has an undo option. For the calculation the three outermost beams (1-3 and 188-191) were not considered. Also a noise factor, filtering and a standard deviation were applied to the calculated grid. All this work was done by the system operators of RV “Sonne”. After the post-processing the data could be exported in an ASCII x,y,z file format with header informations and it was transferred to another workstation where assembling, gridding and contouring with the GMT software (Wessel and Smith 1995) took place (e.g., Figs. 6.2. to 6.48.).

All maps presented in this report are created by M. Grossmann and M. Tormann (RF Reedereigemeinschaft Forschungsschiffahrt GmbH) onboard RV “Sonne” (except of Figs. 4.1., 5.1., 6.1.).

6.1.2. Rock Sampling

Rock sampling on SO 168 was carried out using chain bag dredges. No rocks were obtained with the TV-grab or box corer. Chain bag dredges are similar to large buckets with a chain bag attached to their bottom and steel teeth at their openings, which are dragged along the ocean floor by the ship or the ship´s winch.

Selection of Dredge Sites

Sites for detailed SIMRAD EM 120 mapping and dredging were chosen on the basis of a number of existing datasets. These included:

1. TOPEX bathymetric maps, derived from gravity data,
2. regional magnetic and satellite gravity maps (Davy 1996a, b, Sutherland 1996),

3. multichannel seismic (MCS) lines provided by the Institute of Geological & Nuclear Sciences (GNS), shot as part of the New Zealand Continental Shelf Programme,
4. swath bathymetry maps of part of the Rapuhia Scarp and Wishbone Ridge, provided by GNS,
5. published monographs and papers (e.g., Carey et al. 1991, Herzer et al. 1989, Wood et al. 1989),
6. data from GNS's National Petrology Reference Collection and PETLAB database, recording the positions of existing dredge samples, including sets of samples from the Challenger Plateau and Chatham Rise given to GNS in the 1990s by trawler skippers.

Shipboard Procedure

Once onboard, a selection of the rocks were cleaned and, if necessary, cut using a rock saw. They were then examined with a hand lens and microscope, and grouped according to their lithologies and degree of marine weathering. The immediate aim was to determine whether material suitable for geochemistry had been recovered. Suitable samples have an unweathered and unaltered groundmass, empty vesicles, glassy rims (ideally), and any phenocrysts that are fresh. If suitable samples were present, the ship moved to the next station. If they were not, then the importance of obtaining samples from the station was weighted against the available time. A second dredge nearby and on the same station was sometimes possible.

Fresh blocks of representative samples were then cut for thin section and microprobe preparation, geochemistry and further processes to remove manganese and/or to extract glass (if applicable). Each of these sub-samples, together with any remaining bulk sample, was described, labeled, and finally sealed in either plastic bags or bubble wrap for transportation to GEOMAR or cooperating institutions.

6.2. CHALLENGER PLATEAU

Mount Spong Seamount (DR 1-2)

Mount Spong is the informal name given to a distinctive commercial fishing mark on the western edge of the Challenger Plateau. Some 13 years ago a sample of altered alkali olivine basalt/basanite was recovered from Mount Spong by a trawler (Carey et al. 1991). This is lodged in the Institute of Geological & Nuclear Sciences (GNS) National Petrology Reference Collection as sample P51092.

While in transit across the Tasman Sea on SO 168, it was decided to resample Mt. Spong in the hope that more, and less altered lava samples could be obtained. At the latitude and longitude recorded by Carey et al. (1991), an oval crater shape was recognisable on the SIMRAD EM 120

bathymetry (Fig. 6.2.). The crater is approximately 1.5 x 1 km in size, elongated in a NNE-SSW direction. Its rim rises ~125 m above the flat crater floor but is only ~50 m above the surrounding flat plain of the Challenger Plateau. A significant 10 km wide gravity anomaly is present over Mount Spong; it is probable that the crater is just the emergent tip of a much larger, possibly Late Eocene (Carey et al. 1991) volcano that has almost been buried beneath the sediment cover of the Challenger Plateau. Two dredges on the inner western wall of the depression both recovered volcanic rock samples ranging from volcaniclastic breccias to lavas. Provisional identification of nepheline as a phenocryst is consistent with a highly undersaturated, intraplate volcanic suite.

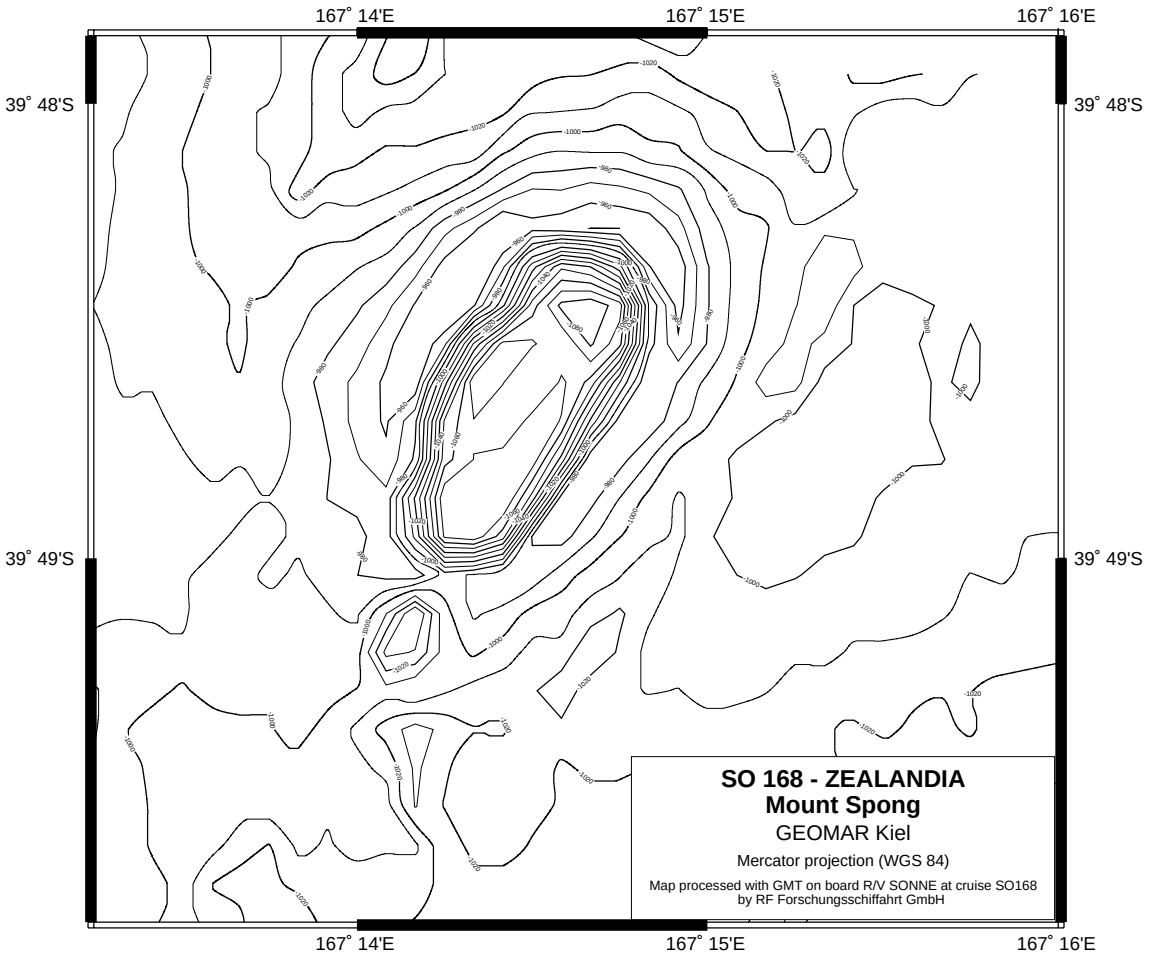

Fig. 6.2.: Bathymetric map of Mont Spong Seamount on the Challenger Plateau.

6.3. HIKURANGI PLATEAU

The Hikurangi Plateau covers an area of 350,000 km^2 and is believed to be a Large Igneous Province (LIP), although before the SO 168 cruise only a single dredge had produced volcanic samples (Mortimer and Parkinson 1996). Seismic, gravity and magnetic studies of the Hikurangi Plateau were not able to distinguish between continental or oceanic nature of the Hikurangi crust

(Wood and Davy 1994, Davy and Wood 1994). In this cruise report, the work on the Hikurangi Plateau is described in terms of three separate geographic-geological regions: (1) guyot-shaped seamounts in the interior part of the plateau, (2) ridge-shaped seamounts on the NE edge of the plateau, and (3) the Rapuhia Scarp, a major fault structure, on the northern edge of the plateau.

6.3.1. Interior Guyot-type Seamounts

Ten large seamounts in the interior of the plateau with heights of 1,000 - 1,650 m above the plateau floor were mapped with the SIMRAD EM 120 multi-beam echo system and sampled by dredging.

Shipley Seamount (DR 7-10)

Shipley is the southwesternmost seamount sampled on the Hikurangi Plateau. It was selected on the basis of its large regional gravity anomaly (Davy 1996a, b) and significant height above the plateau on TOPEX predicted bathymetry maps. No pre-existing samples, or seismic or swath coverage were available.

SIMRAD EM 120 mapping revealed the seamount to be a guyot with a roughly circular, steep-sided base and flat top except for several (at least six) smaller volcanic cones (Fig. 6.3.). The base of the seamount lies at ~2,600 m depth and has a diameter of ~18 km. At least three ridges emanate from the base in the northwest, west and southwest direction, which reach lengths of up to 3 km. These ridges are interpreted as volcanic rift zones formed during the shield stage of the volcano. The flat top (~1,600 m at the edges and ~1,425 m in the center) is interpreted to be an erosional platform being formed by wave activity at sea level. The inward shoaling of the platform is consistent with subsidence occurring contemporaneously with erosion at sea level to form the platform. The younger volcanic cones are well preserved (one of them has a crater in its center), rise to depths of 1,300 m and must have formed after the seamount subsided below wave base. The total net subsidence of the volcano, represented by the depth of the basal erosional platform is ~1,600 m.

Four dredge hauls were made: DR 7 and 8 on the eastern flanks, DR 9 on the southern flank, and DR 10 on the easternmost cone on the seamount top which has a discernable crater on the SIMRAD EM 120 map. DR 8 and 10 were empty. DR 7 and 9 yielded ol-cpx porphyritic lavas and volcanic breccias; additionally DR 9 contained some aphyric lavas as breccia clasts cemented by Mn, and some nodular phosphatised limestone. Site DR 9 was made in a topographically complex area on the south side of Shipley, possibly a submarine landslide. One possible interpretation is that the bulk of Shipley seamount consists of cpx±ol basalts as sampled at DR 7 and 9, whereas the young plateau flows consist of a different suite of aphyric lavas that are found in Mn-cemented breccias with capping phosphatised limestones at DR 9. The greater

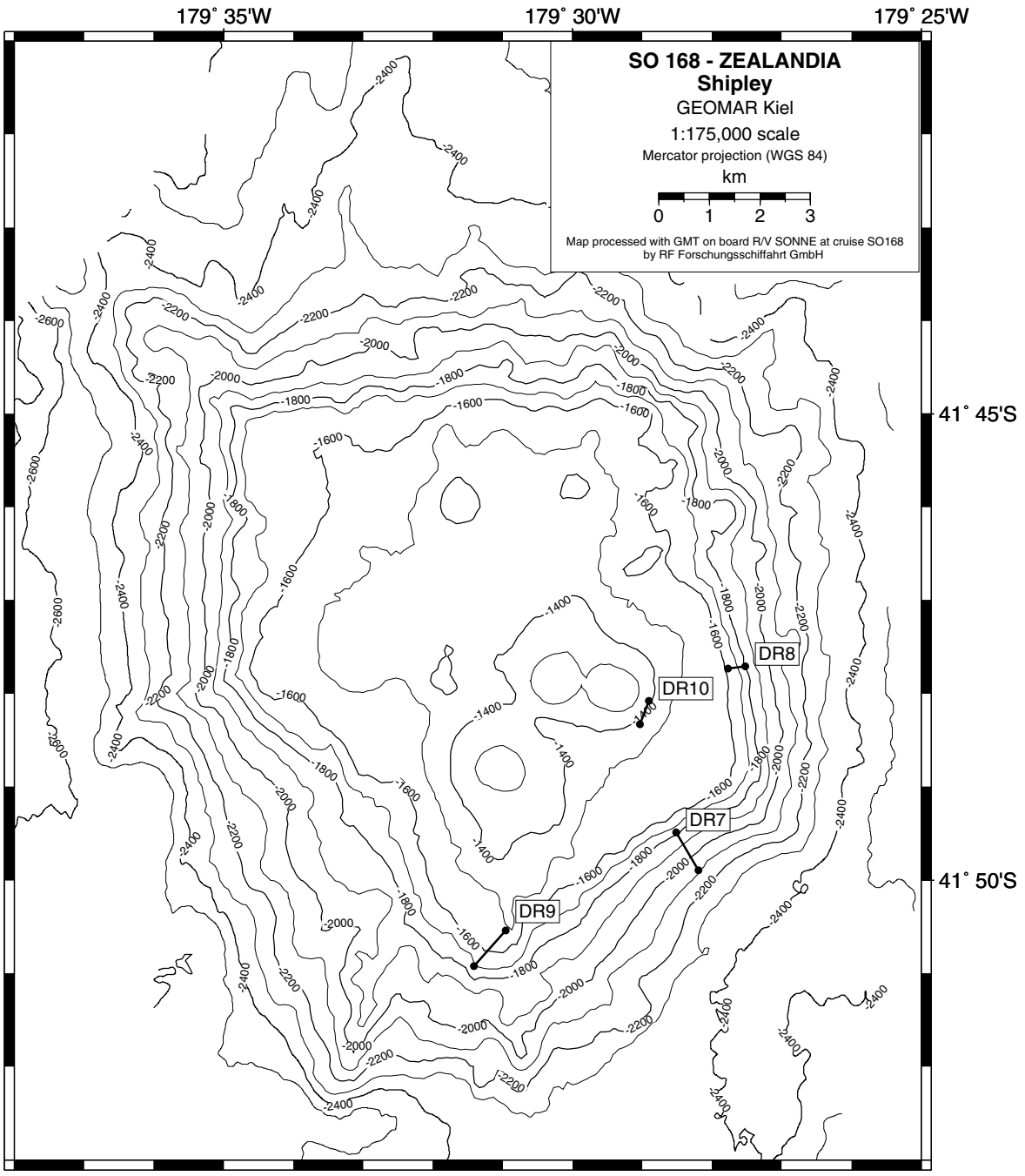

Fig. 6.3.: Bathymetric map of the Shipley Seamount including locations of dredge tracks DR 7 - 10.

thickness of Mn rinds (up to 20 cm) on Shipley rocks contrasts with the thin rinds on the Graveyard seamounts 80 km to the south (and probably indicates greater [e.g., Cretaceous]) age. The cpx±ol lavas are not typical of Large Igneous Province (LIP) subalkaline basalt suites.

Bolger Seamount (DR 11)

Bolger Seamount is located ~60 km north of Shipley Seamount on the western Hikurangi Plateau. Like Shipley, this was selected for dredging solely on the basis of its gravity/bathymetry expression on regional scale maps; no other information was available on the seamount.

SIMRAD EM 120 mapping showed Bolger Seamount to be a smaller volcano than Shipley (Fig. 6.4.), ~10 km in diameter at the base (depth 2,800 m). It also appears to be a guyot with a crudely circular base that rises to a flat, probably wave-eroded, plateau (~4 km in diameter). The outer part of the plateau occurs at depths of 1,575 m and the interior at depths of 1,500 m. Small cones and ridges were identifiable on the flanks of Bolger, but not on the top plateau. A single dredge of a cone-like feature on the eastern flank produced only Mn crusts. In view of the shallower slope angles compared to Shipley, no further dredging was attempted.

Moore Seamount (DR 12-15)

Moore Seamount is located ~70 km north of Bolger Seamount on the western Hikurangi Plateau. No pre-existing seismic or detailed bathymetric data were available for Moore. Moore has a gravity anomaly comparable to Shipley.

Moore is an oval-shaped guyot volcano, 25 x 16 km at its base, elongated in a NNW-SSE direction (Fig. 6.5.). It rises from the Hikurangi Plateau at ~3,000 m to a flattish top between 2,150 - 1,950 m and has about a dozen <1 km diameter cones constructed on its top with peaks up to 1,700 m below sea level. The guyot form is strikingly like Shipley and Bolger, but slightly deeper. Four dredges were conducted on Moore Seamount. DR 14, on the southern flank, was empty and DR 15, on the southernmost top cone, yielded mainly Mn crusts with only two corroded cores of volcaniclastic sandstone. DR 12, on the upper half of the main NE (steepest) flank of Moore, yielded about two dozen joint blocks of a fine-grained, mainly non-vesicular aphyric basaltic to intermediate composition. DR 13, on the 300 m high northern cone on top of Moore, yielded a different suite of lavas – scoriaceous olivine basalts, probably spatter from the cone. Vesicles are filled with calcite. Also in the dredge were volcanic (palagonitic) breccias, sandstones and limestones. DR 13 seems to have sampled the sedimentary and volcanic top of Moore. It should be noted that some 90% of DR 13 consisted of Mn crusts and nodules of up to 6 cm radius/thickness. Thus even the youngest identifiable volcanic features on the Hikurangi Plateau seamounts are covered by appreciable thicknesses of Mn.

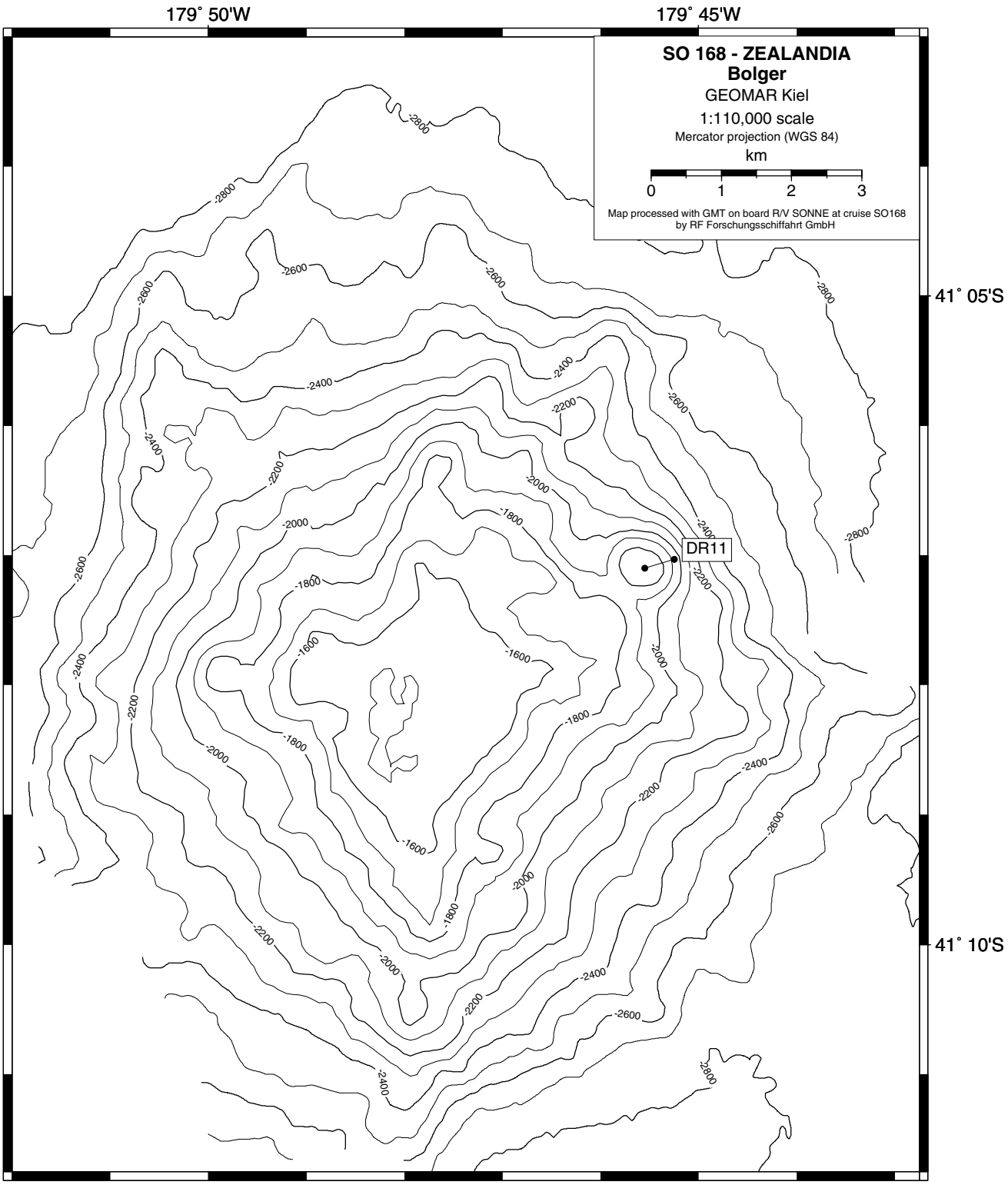

Fig. 6.4.: Bathymetric map of Bolger Seamount including location of dredge track DR 11.

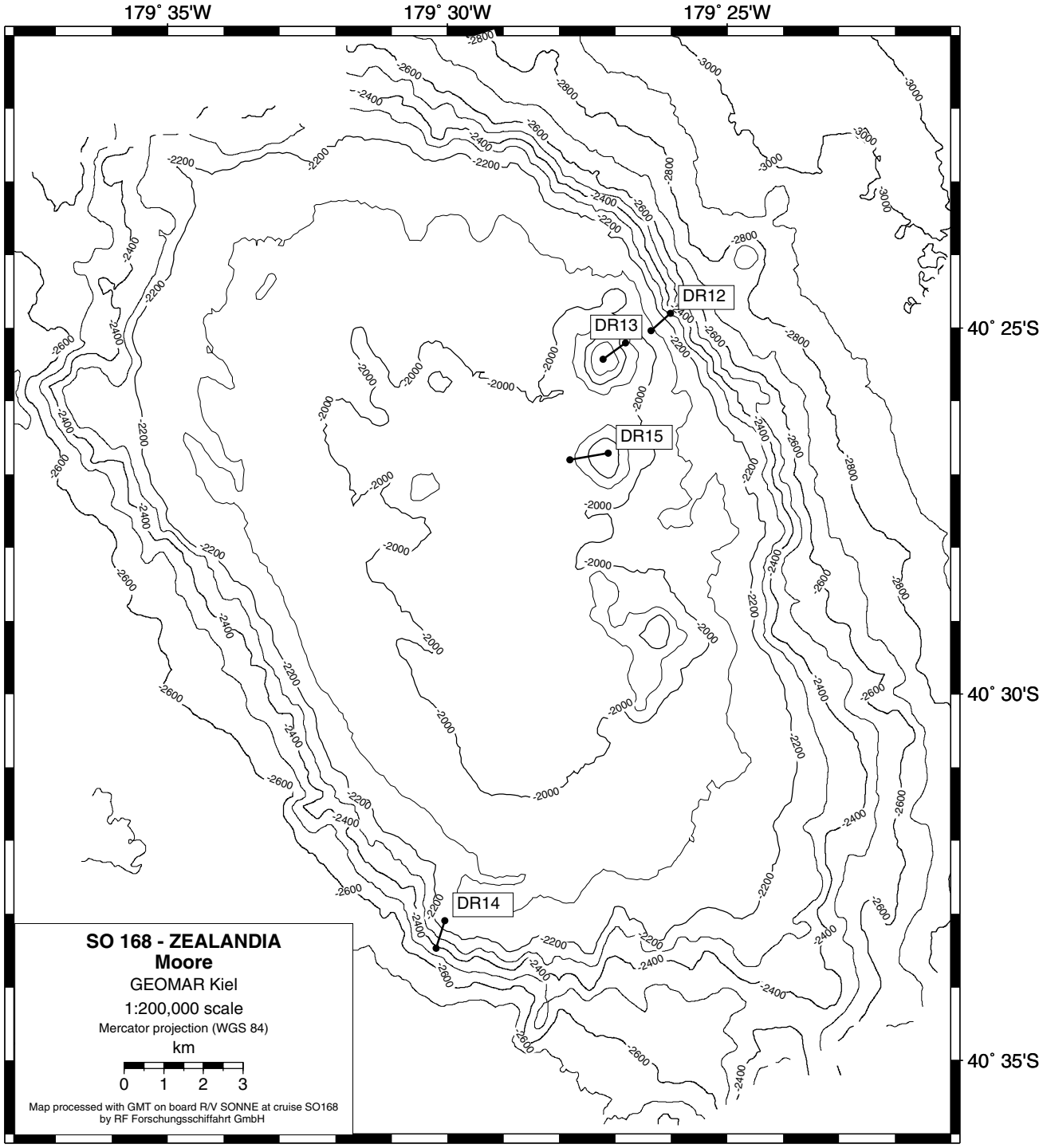

Fig. 6.5.: Bathymetric map of Moore Seamount including locations of dredge tracks DR 12 - 15.

DR 13 volcanic breccias contain clasts of lithified foram ooze that is not completely phosphatised. The ooze including planktic and a few benthic forams. Breccia cavities are filled with (inorganic) calcite cements. Two generations of rim cements are clearly distinguished: a thin, dark-gray rim of radial crystals (possibly high-Mg calcite), and a thicker whitish radial rim of low-Mg calcite. Remaining pore space is filled by granular calcite or by single euhedral calcite crystals that grow into vugs.

Rowling Seamount (DR 18-19)

Rowling Seamount is located ~120 km northwest of Moore Seamount on the westernmost Hikurangi Plateau and immediately adjacent to the Hikurangi Trench. Rowling and neighbouring Kirk Seamount were sampled in the hope that faulting near the subduction zone may have recently exposed parts of these seamounts not covered with manganese crusts. Indications that this might be the case were seen in linear sides to Rowling Seamount on plots of RV “Atalante” swath bathymetry (Collot et al. 1996) provided by GNS. Rowling is also marked by a moderate gravity anomaly.

All but the southernmost part of Rowling was mapped with SIMRAD EM 120 bathymetry (Fig. 6.6.). Plateau depth at the base of the irregular shaped, N-S elongated 20 x 10 km seamount is 3,400 m. The significantly deeper depth than found at Moore could result partly from the location of Rowling near the eastern Hikurangi Trench. Unlike Shipley, Bolger and Moore, there is no clearly discernable plateau on Rowling, though speculatively there is a poorly defined one at ~2,500 - 2,400 m. The tops of the highest volcanic cones reach up to 2,100 m. Contrary to expectations, no linear (tectonic) features were visible on the SIMRAD EM 120 swath map. Dredge DR 18 was made on the eastern (both steepest and highest) slope of Rowling. It yielded mainly palagonite breccias (hyaloclastites, some possibly containing fresh glass), bedded sandstones, and a few vesicular basalt samples. Features of the basalts included sparse altered olivine phenocrysts, palagonite rinds and possible micropillow shapes. Dredge DR 19 on a small cone on the north slope of Rowling, was also dominated by palagonite breccias, some containing vesicular/amygdaloidal basalts with definite fresh glass. Despite the proximity to Taupo Volcanic Zone, no pumice was present in the Rowling dredges.

Kirk Seamount (DR 20-22)

Kirk Seamount is located ~55 km northeast of Rowling Seamount on the western Hikurangi Plateau and is ~80 km from the axis of the Hikurangi Trench. No pre-existing seismic or detailed bathymetric data were available for Kirk. Kirk has a gravity anomaly comparable to Rowling. Isobaths on the TOPEX bathymetric map showed cone and crater-like features on the eastern top of Kirk, and a steep, linear WSW side.

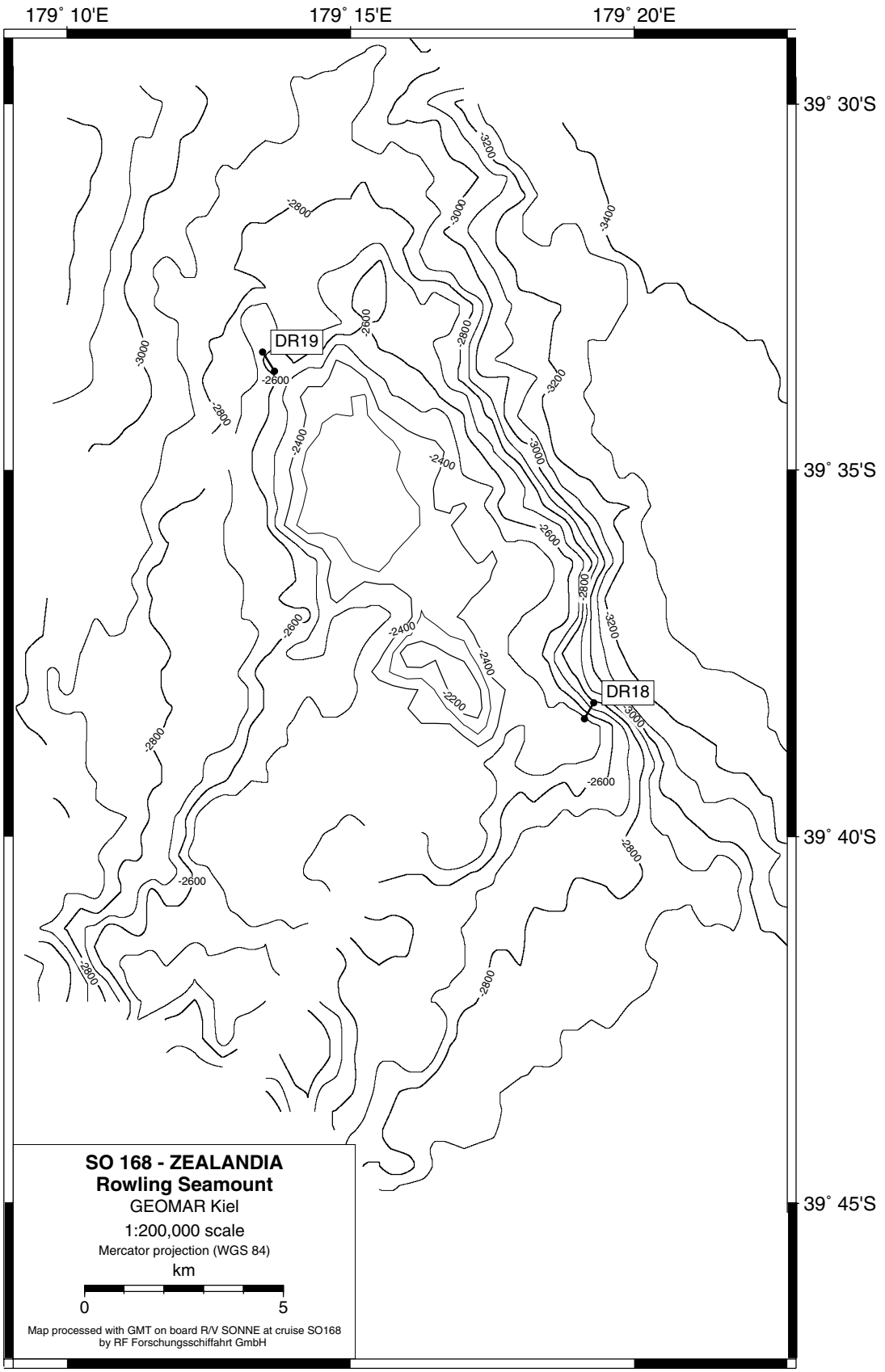

Fig. 6.6.: Bathymetric map of Rowling Seamount including locations of dredge tracks DR 18 and DR 19.

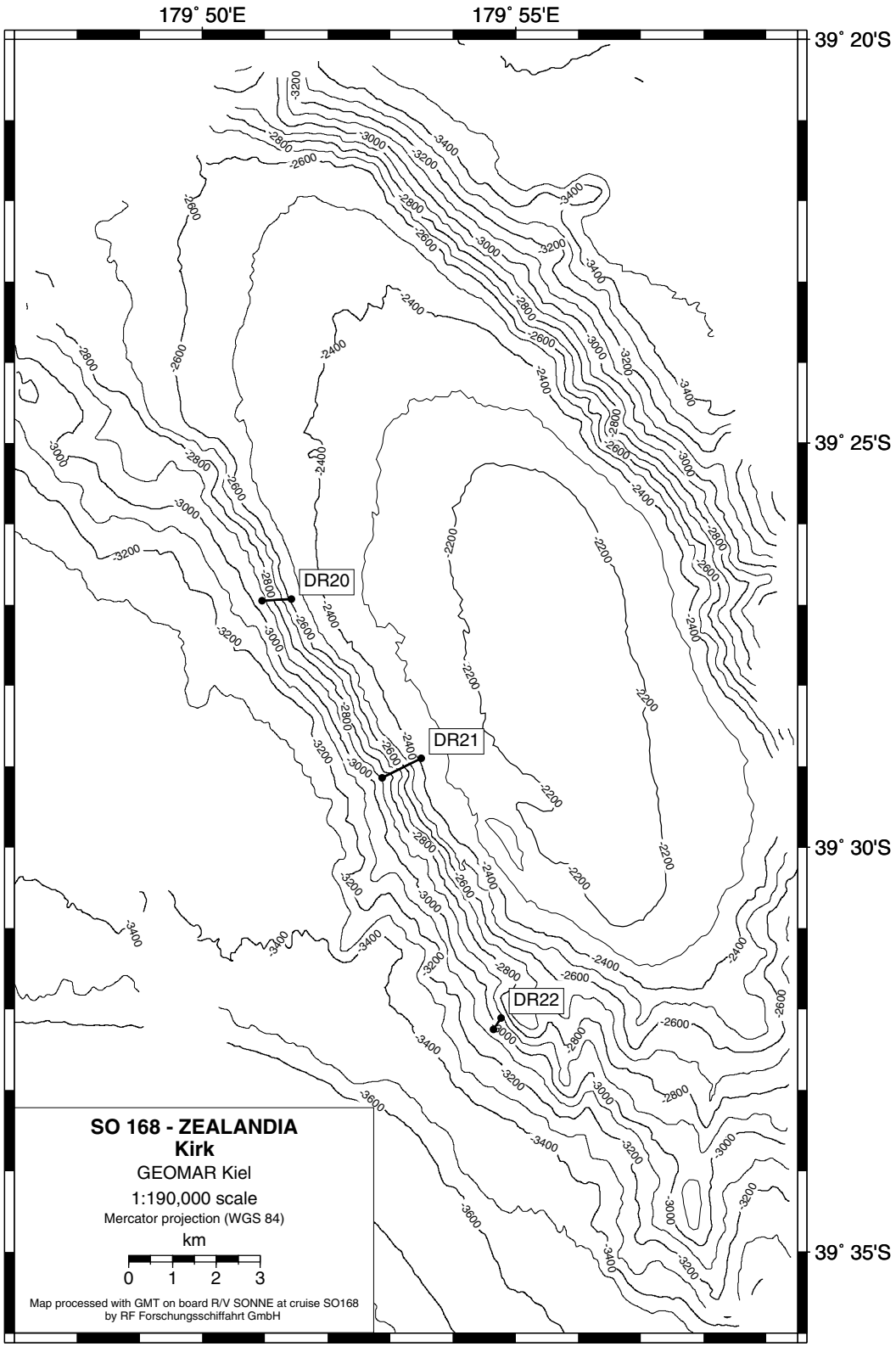

Fig. 6.7.: Bathymetric map of Kirk Seamount including locations of dredge tracks DR 20 - 22.

Because of technical limitations, SIMRAD EM 120 mapping was confined to west of 180° longitude (Fig. 6.7.). The mapping confirmed the steep WSW side of Kirk but showed the other TOPEX eastern top features to be incorrect. The main Hikurangi Plateau is at about 3,400 m depth around Kirk. The Hikurangi Channel is clearly visible immediately south of Kirk on the SIMRAD EM 120 map and has incised a canyon about 200 m deep. Kirk has a 25 x 10 km oval shaped base, elongated NNW-SSE. Both eastern and western slopes are steep, the NW slope has a distinctly shallower gradient than the others. The top of Kirk is a broad dome with a top between 2,300 - 2,150 m; Kirk is thus considered to be a guyot. The shallower slope of the NW end of Kirk may represent trenchward tilting of the erosional plateau. Two successful dredges were made. DR 21 gave mainly non-vesicular olivine microphyric basalt, with some non-palagonitic breccias. DR 22 gave mainly yellow, altered volcanic breccias containing some clasts of (moderately fresh) calcite amygdaloidal olivine basalt.

Palmer Seamount (DR 23-25)

Palmer Seamount is located ~110 km east of Kirk. Like the other Hikurangi Plateau seamounts, Palmer has a large gravity anomaly, though the TOPEX bathymetry showed it to have more shallow slopes, somewhat comparable to Moore. A N-S trending MCS line, HKDC-1, provided by GNS, crosses the east side of Palmer. The seismic line shows that Palmer has a guyot-like profile with relatively steep sides and flattish dome-like, sediment covered top. Small, sediment-free volcanic peaks, south of Palmer were also visible on the seismic line but did not appear to be connected to Palmer.

SIMRAD EM 120 mapping confirmed that the main part of Palmer looks like a guyot (Fig. 6.8.). It also revealed the presence of a 20 km long, curvilinear constructional volcanic rift system with abundant cones on its top emanating from the southwestern edge of the guyot and extending to the south. The two peaks seen on the seismic line lie at the southern end of the rift system. A constructional volcanic rift also appears to emanate from the northern part of the main edifice of Palmer but was not mapped over its entire extent (TOPEX bathymetry suggests it may be similar in length to the southern rift system). Like most of the seamounts mapped so far, the main mass of Palmer is slightly elongated in a NNW-SSE direction. At its base it measures some 12 x 9 km. It rises from the Hikurangi Plateau at 3,600 m to a pronounced slope break at 2,450 m; the top of the dome is in the center of the seamount at 2,200 m. Two successful dredges were made on the twin cones at the end of the southern rift arm: DR 23 contained a single 1 x 0.5 x 0.5 m manganese boulder with corroded cores of volcanic breccia that contained clasts of highly altered amygdaloidal olivine basalt. A dredge on the other peak gave similar but more usable volcanic and sedimentary material with only thin Mn rinds.

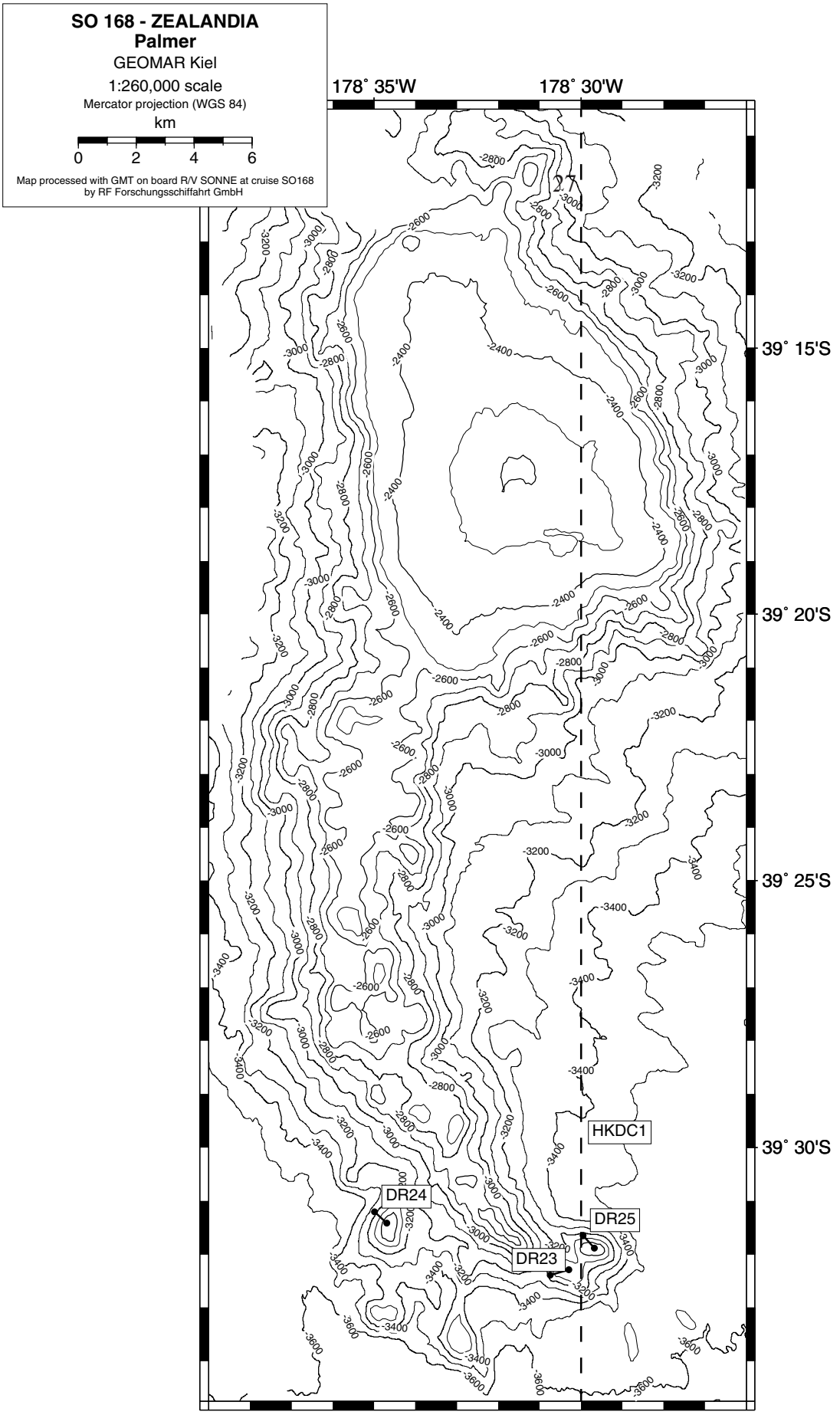

Fig. 6.8.: Bathymetric map of Palmer Seamount including locations of dredge tracks DR 23 - 25 and MCS line HKDC-1 (dashed line).

Lange Seamount (DR 26-28)

Lange Seamount is located ~90 km northeast of Palmer Seamount on the western Hikurangi Plateau. Lange does not actually appear on pre-TOPEX bathymetry maps, but exceeds its neighbour Katz Seamount (named by Wood and Davy 1994) in terms of gravity anomaly and height. Lange has the second largest gravity anomaly (80 mgal) of any seamount on the Hikurangi Plateau, being exceeded only by Polar Bear (see below). No seismic data were available over Lange.

Lange seamount is one of the largest surveyed on the Hikurangi Plateau, being some 25 x 20 km at the base and elongated in a NW direction. SIMRAD EM 120 mapping showed that the seamount is a guyot with a dome-like top, which is 2,775 m at the rim and rises to 2,350 m in the center (Fig. 6.9.). Many small cones are visible around the rim. A large, broad cone-topped ridge, reaching up to 2,700 m, extends at least 8 km south of the main Lange mass and appears to be part of a constructional volanic rift arm. A second rift arm may emanate from the northwest of Lange seamount but was not mapped. Abyssal plain depth is 4,000 m. Three dredges were made on Lange but only one, DR 26 made on a small cone at the SW base, yielded useful volcanic rocks: black-brown aphyric lavas and yellow-brown volcanic breccias.

Katz Seamount (DR 29)

Katz Seamount is located ~30 km northeast of Lange. This seamount appears as a large, isolated peak in the digital terrain model figure of Wood and Davy (1994). TOPEX bathymetry and regional gravity maps reveal that Katz actually has two larger close neighbours, Lange and Muldoon. The end of GNS seismic line HKS2a crosses the top of Katz seamount and shows it (along the SW-NE profile) to be symmetrical, steep sided and topped by a flattish dome. About 0.1 s TWT of prominent reflectors indicates a sediment blanket of ≥100 m on the seamount top.

Katz Seamount was only partially surveyed but is some 14 km in east-west width, and appears to be elongated in a N-S direction (Fig. 6.10.). It rises from abyssal plain depths of 4,100 - 4,000 m to dome-like top with a rim at 2,900 m and center at 2,650 m. Dredge DR 29 from a very steep canyon on the east side of Katz gave the best quality lavas from any seamount on the Hikurangi Plateau. The volcanic rocks included fresh, non-vesicular, holocrystalline olivine and plagioclase basalts and volcanic breccias.

Muldoon Seamount (DR 30)

Muldoon Seamount is located ~30 km northeast of Katz. Muldoon sits on the edge of the Hikurangi Plateau and is the easternmost seamount studied on the western part of the plateau. Although only partially surveyed by SIMRAD EM 120, it appears to be T-shaped (two joined ridges) in map profile. The >40 km long, main part of the seamount reaches an elevation of

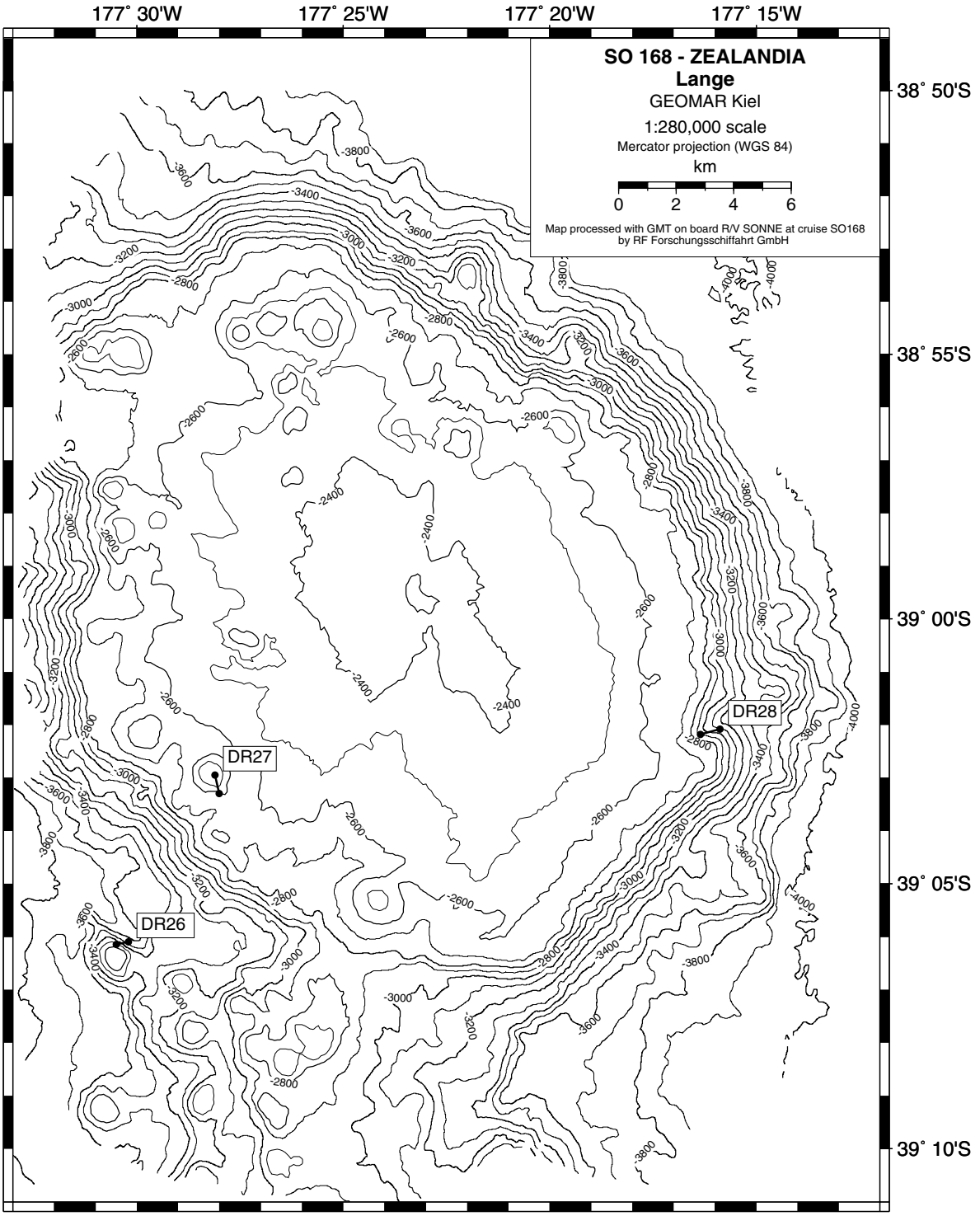

Fig. 6.9.: Bathymetric map of Lange Seamount including locations of dredge tracks DR 27- 29.

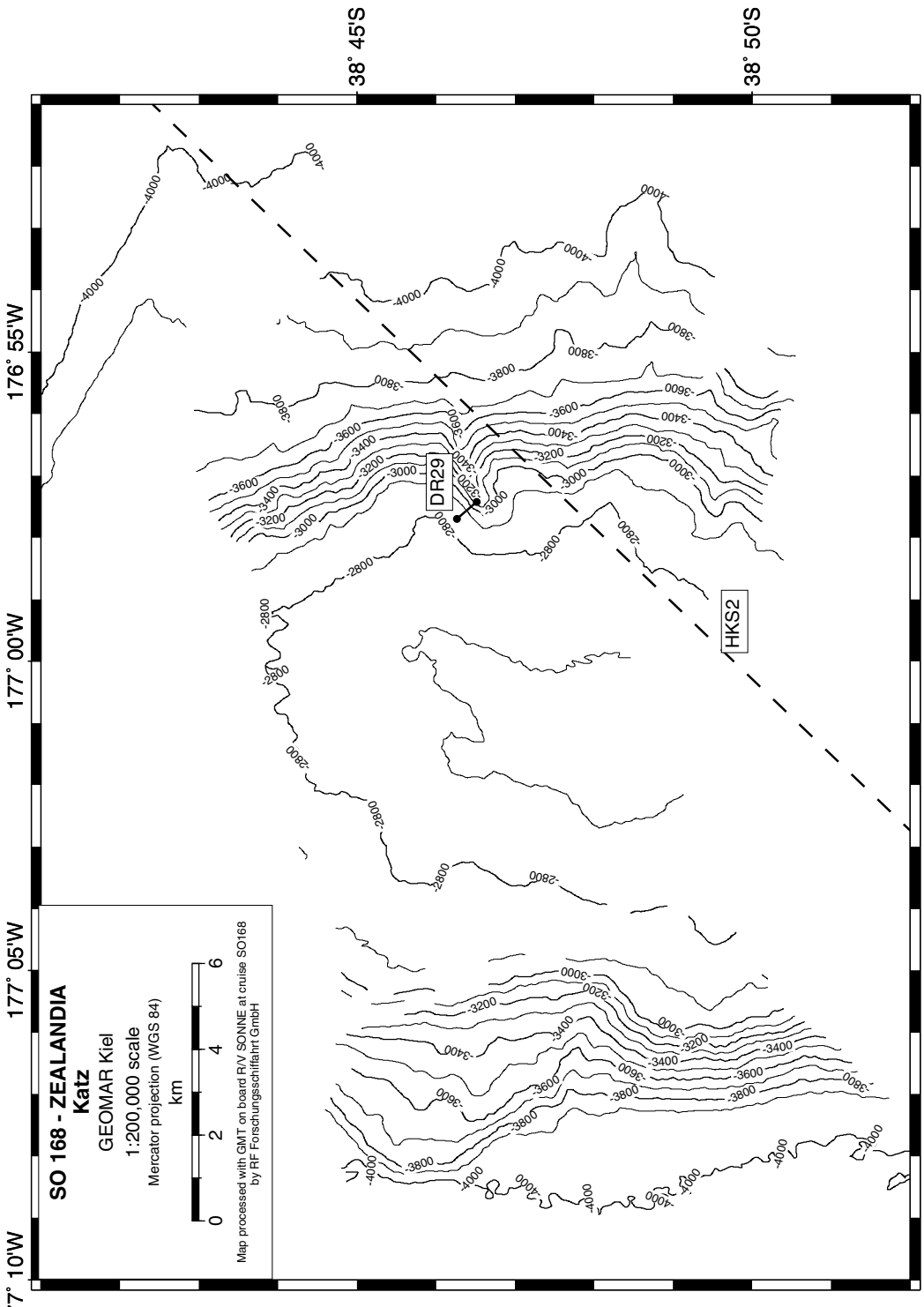

Fig. 6.10.: Bathymetric map of Katz Seamount (central part) including locations of dredge track DR 29 and GNS seismic line HKS2a.

2,900 m water depth and is elongated in the NNW and SSE directions, i.e. subparallel to the northeast edge of the Hikurangi Plateau. The >20 km long WSW-trending ridge reaches elevations of 3,300 m water depth and falls gently in elevation to the WSW (this dip, with SW-tilted sedimentary cover, is clearly seen in GNS seismic line HKS2b). On its east side, Muldoon rises from the abyssal plain of the Pacific ocean crust at 4,400 m (Hikurangi Channel is incised to 4,700 m). On its other sides, Muldoon rises from the Hikurangi Plateau at ~4,100 m (this is also the depth of the plateau separating Katz and Muldoon). Dredge DR 30 was made on the eastern side of Muldoon. It yielded a single, 0.1 kg piece of fresh, vesicular olivine basalt.

The SIMRAD EM 120 bathymetry and GNS seismic line HKS2b suggest that the WSW arm of Muldoon may have once been a guyot that was tilted due to faulting (Fig. 6.11.). The >40 km linear elongation of the main Muldoon Ridge (NW-SE) parallel to the Plateau margin and Rapuhia scarp (which is clearly seen as a partly buried 200 m high sea floor scarp in HKS2b northeast of Muldoon at 38°19.0'S, 176°18.2'W) suggests formation of at least this part of the seamount along an extensional fault subparallel to the one forming the Rapuhia Scarp. These faults and associated volcanics are discussed and described at greater length in section 6.4.

Muldoon may have had a complex, at least two- or three-stage, evolution: (1) the SW ridge erupted and was eroded to form a guyot like the other internal Hikurangi Plateau seamounts; (2) the guyot top was split and tilted to the SW, mainly by faulting on the NE edge of Muldoon; (3) later magmas ascended along the fault plane forming the main >40 km NW-SE ridge. Dredge DR 30 was carried out from 3,600 to 3,300 m water depths; although this is at the depths of the older volcanic structure it can’t be ruled out that the sample rolled down the hill from the younger post-fault part of the seamount.

Polar Bear Seamount (DR 48-50, TVG 51-52, GKG 53)

Polar Bear is the only guyot-shaped seamount that was mapped and sampled on the eastern interior part of the Hikurangi Plateau. Polar Bear has the largest positive gravity anomaly (90 mgal) of any seamount on the Hikurangi Plateau. The portion of MCS line HKDC4 provided by GNS ended at the top of Polar Bear and was suggestive of a guyot-like form. Polar Bear measures ~25 x 20 km at the 2,900 m base. Two NE-NNE trending sublinear young volcanic cone alignments are visible across the flattish 2,000 m deep seamount top (Fig. 6.12.).

Two dredges on Polar Bear gave very good petrological material. Dredge DR 49 gave a variety of fresh, mainly non-vesicular basalt lavas with varying proportions of olivine (altered), clinopyroxene, plagioclase and FeTi-oxide; aphyric basalts were also present. Volcaniclastic conglomerate (as opposed to breccia) was present, supporting the fluvial and/or wave reworking of the guyot top. Dredge DR 50 yielded black basalts with <1% olivine and clinopyroxene phenocrysts; possible fresh glass was seen within the palagonite rind on one sample.

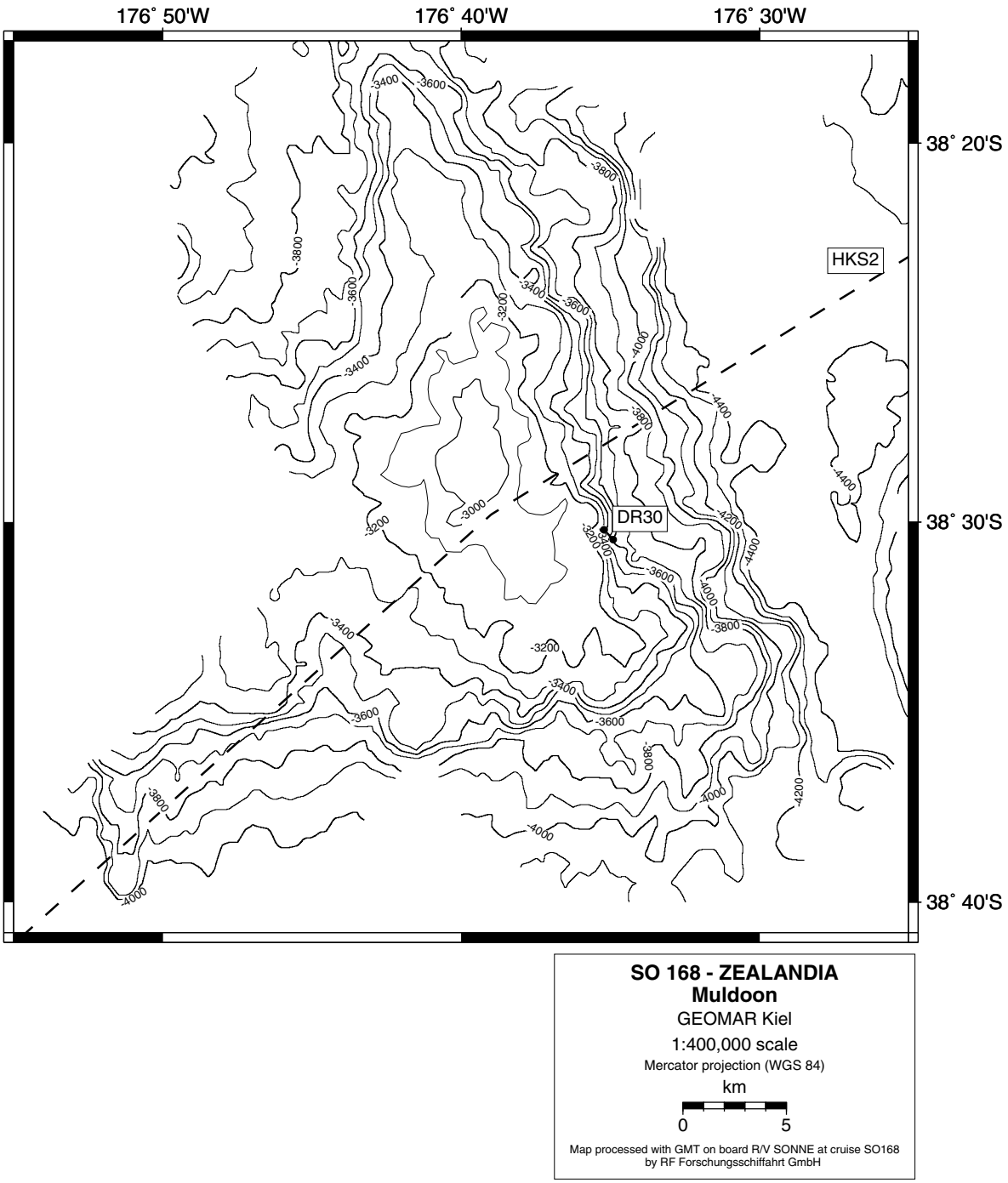

Fig. 6.11.: Bathymetric map of Muldoon Seamount including locations of dredge track DR 30 and GNS seismic line HKS2b.

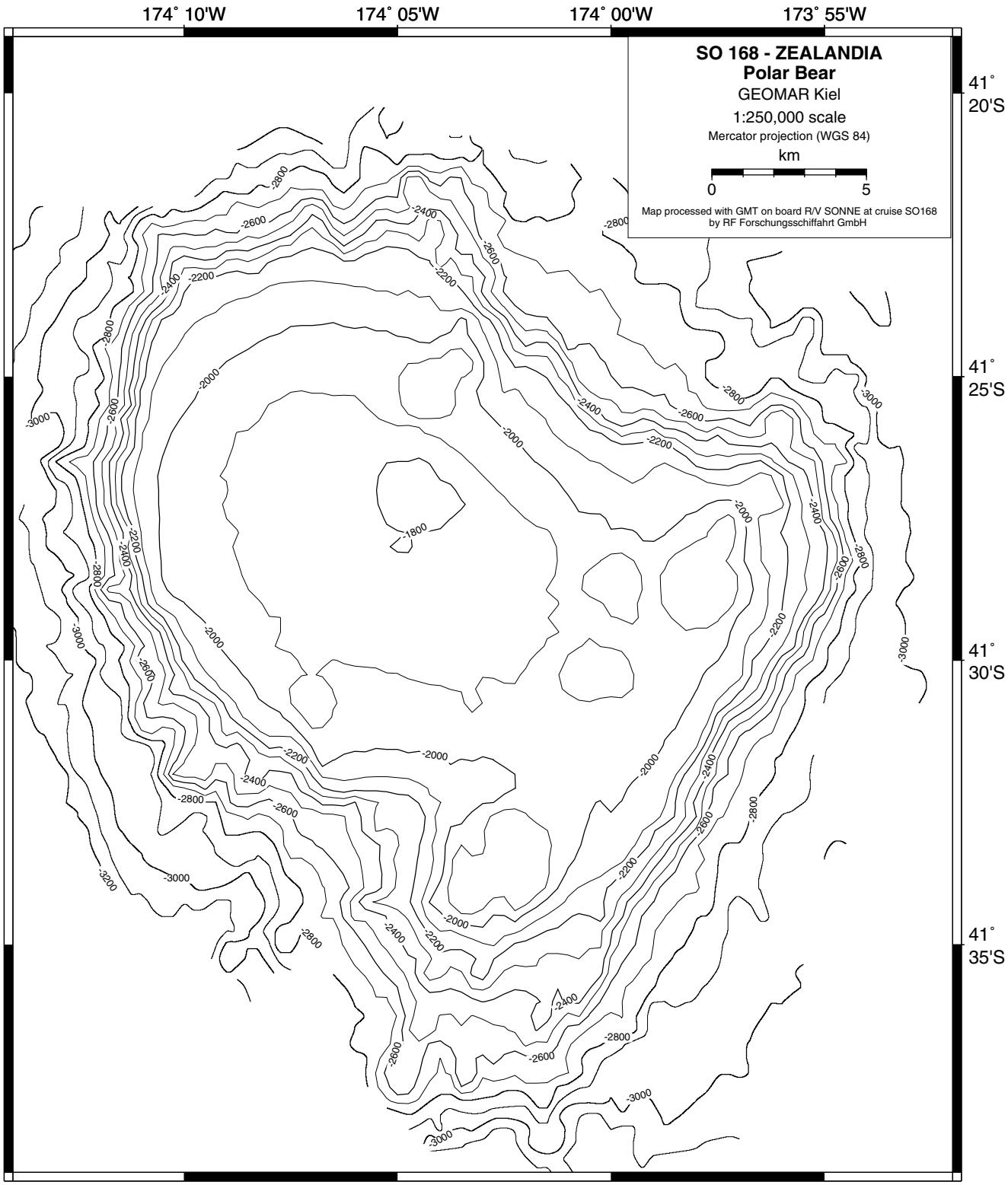

Fig. 6.12.: Bathymetric map of Polar Bear Seamount including locations of dredge tracks DR 48 - 50, TV-grabs 51 and 52, and gaint box corer 53.

At station 51 on the top of Polar Bear a TV grab was made. The camera passed over some sediment-free areas in which pillow lava outlines, and possibly a dike wall, could be clearly seen. Sediments were recovered with the TV grab and box corer for biological investigations.

Summary

Volcanic and/or volcaniclastic rocks were dredged from nine of the ten interior seamounts (Fig. 6.13.) mapped with SIMRAD EM 120 (only Mn-Fe-oxides were obtained from Bolger Seamount). Samples ranged from basalts (aphyric or containing varying abundances of olivine, plagioclase and clinopyroxene phenocrysts) to volcaniclastic breccias (hyaloclastites and lapilli tuffs). Manganese-iron (Mn-Fe) crusts and nodules were obtained from most seamounts and often exceeded 10 cm in thickness. Lesser amounts of indurated siliceous, phosphatic and calcareous rocks and conglomerate and sandstone were also recovered from many seamounts. The multi-beam SIMRAD EM 120 swath mapping recovered samples clearly indicating that the seamounts are volcanic in origin; individual volcanic cones and cones coalesced into rift systems (reaching 20 km in length) were clearly recognizable in the swath bathymetry.

The most striking feature of all the seamounts is their guyot-like form, characterized by steep sides and a relatively flat top (up to 24 km across with ≤400 m variation in height from the margin to the center). The morphology of these seamounts and sandstones and conglomerates obtained from some of the platform edges are consistent with an erosional origin for these platforms. Therefore all of these seamounts are believed to have once formed islands which were eroded to sea level. This hypothesis is also consistent with the types and textures of recovered volcanic rocks, which suggest derivation in shallow water or possibly under subaerial conditions. Although the platforms appear to be flat in comparison to the steep sides of the seamounts, they actually consist of gentle domes. A positive correlation between the minimum outer diameter of the dome (some have oval bases) versus the height of the center of the dome (relative to the outer margin) suggests that volcano diameter at sea level is the controlling factor in the rate of erosion of these seamounts and that these seamounts subsided at a similar rate.

The depths of the platforms increase systematically from 1,575 m in the south to 3,300 m in the north, indicating that the Hikurangi Plateau has undergone substantial subsidence and northwards tilting after erosion of the seamount volcanoes to sea level. Small cones located on many of the top platforms must have formed after the erosional platforms subsided below wave base. All samples from these late stage cones were highly vesicular, consistent with eruption in shallow water depths. The depth of the sea floor at the base of the volcanoes also increases systematically northward from 2,600 to 4,200 m. The height of the erosional platform above the base of the volcano is relatively constant, between 900 - 1,225 m. Assuming similar ages for the seamounts and a constant sediment thickness of ~400 m as suggested by seismic data (Wood and

Davy 1994), it appears that the surface of the Hikurangi Plateau was approximately flat and located at ~1,500 m depth at the time the seamounts were eroded to wave base. Age data from Hikurangi Plateau lavas should allow us to constrain its subsidence rate and history.

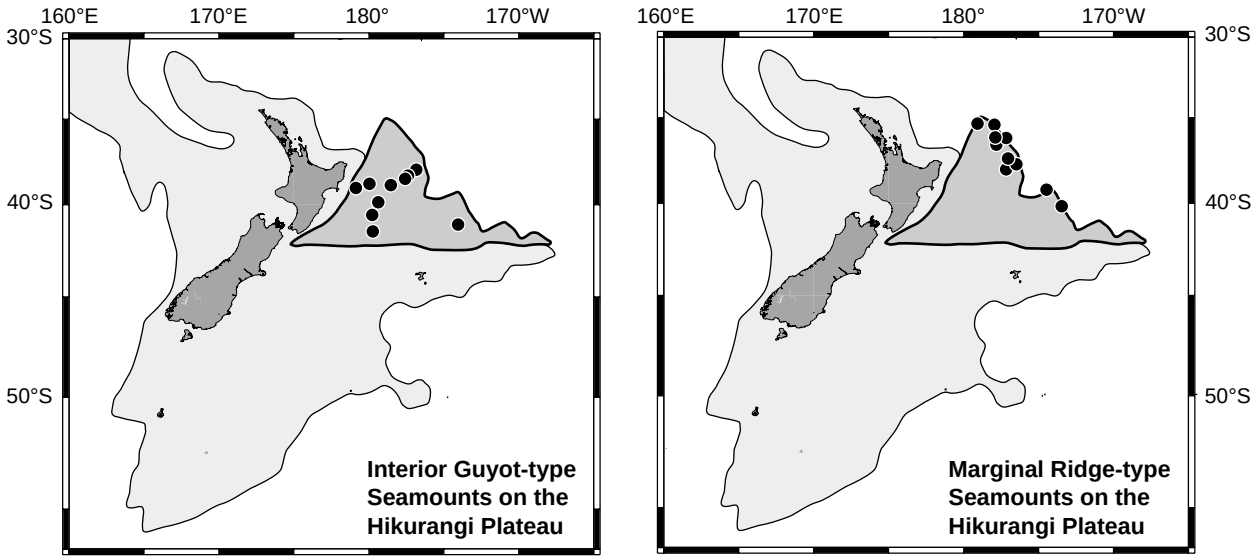

Fig. 6.13.: Distribution of guyot-type seamounts and ridge-type seamounts dredged on SO 168 cruise (black dots) on the Hikurangi Plateau.

6.3.2. Marginal Ridge-type Seamounts

The ridge-type seamounts are morphologically distinct from the guyot-type seamounts in that they comprise elongated linear features with sharp tops, rather than subrounded features with flattish tops. In contrast to the guyots which occur within the interior of the Hikurangi Plateau, the ridge-type seamounts occur exclusively along (within 70 km of) the northeastern margin of the Hikurangi Plateau (Fig. 6.13.). Some seamounts (e.g., Muldoon, possibly Marshall), may be composites of guyot and ridge-type shape and origin. On the NW part of the margin, the mapped ridges (Marshall, Holyoake, Nash, Holland, Fraser, Savage and Kiwi) trend N to NNW, and are often parallel to the plateau margin. In contrast, along the southeastern margin of the Hikurangi Plateau (Skua, Penguin, Hoiho), the ridges trend NNE (25° to 40°) at a high angle to the plateau margin. The linear ridges are interpreted from SIMRAD EM 120 maps as constructional volcanic features whose origin is probably fault controlled. The alignments of ridges may be related to normal and strike-slip faulting associated with the break-up of the paleo Hikuhiki (**Hiku**rangi-Mani**hiki**) Plateau.

Marshall, Holyoake and Nash Ridges (DR 31)

Marshall, Holyoake and Nash (in west to east order) are a group of seamounts approximately 60 km north of Lange, Katz and Muldoon. As with the latter chain, Marshall is identifiable as a regional gravity anomaly, and on the TOPEX bathymetry map. GNS sesimic line HKS1b crosses Marshall, Holyoake and Nash. In seismic cross-section, Holyoake and Nash are sharp ridges and Marshall has sediments ponded between two peaks. On HKS1b, the Rapuhia Scarp is clearly seen as a partly buried 200 m high sea floor scarp in HKS2b northeast of Nash at 37°44.5'S, 176°29.0'W)

SIMRAD EM 120 mapping showed that Marshall (maximum elevation = 2,500 m water depth), Holyoake (2,600 m) and Nash (3,000 m) are all ridge-like structures elongated in a NNW (–45°, -35° and 0° respectively) direction (Figs. 6.14. - 6.16.). The south end of Marshall is broader in E-W direction than the other two ridges. From SIMRAD EM 120 it may be possible to define a ~2.600 m flattish top (but not as flat as Katz or Palmer guyots) at the south end of Marshall with sediment cover dipping (in seismic section) to the SW. 100 - 200 m high volcanic cones have been constructed on the plateau and continue into the clearly linear volcanic ridge to the north. Our preferred interpretation of Marshall is that it consists of at least two or three separate NNW-trending volcanic ridges, with sediment and/or volcanic infill having led to their coalescence as a single upstanding feature. Alternatively, it is possible that Marshall may be a strongly faulted and back tilted and re-intruded guyot like Muldoon. The Hikurangi Plateau depth between Marshall and Holyoake is 4,000 m and between Holyoake and Nash is 4,100 m.

Dredge DR 31, made on one of the top cones of Marshall was unsuccessful. No other appropriate dredge sites were found on the these seamounts.

Holland, Fraser and Savage Ridges (DR 41-42)

Holland, Fraser and Savage Ridges lie on the northwestern edge of the Hikurangi Plateau near the Rapuhia Scarp. These ridges appear as bathymetric anomalies on the TOPEX maps, but their shape is unclear. GNS MCS line OHKS1a cuts across the south end of Savage. Unlike the other lines, a clearly faulted Rapuhia Scarp is not visible and features are difficult to interpret, but the steep eastern side of Savage and three or four volcanic peaks can be seen.

The three ridges were mapped to varying degrees with SIMRAD EM 120. Holland, Fraser and Savage strike NNW to SSE at -20°, -10° and -40° respectively with Savage close to the -45° orientation of the Rapuhia Scarp (Figs 6.17. and 6.18.). Like Marshall, Holyoake and Nash, this group of three ridge-like seamounts is also interpreted to have formed along faults involved in

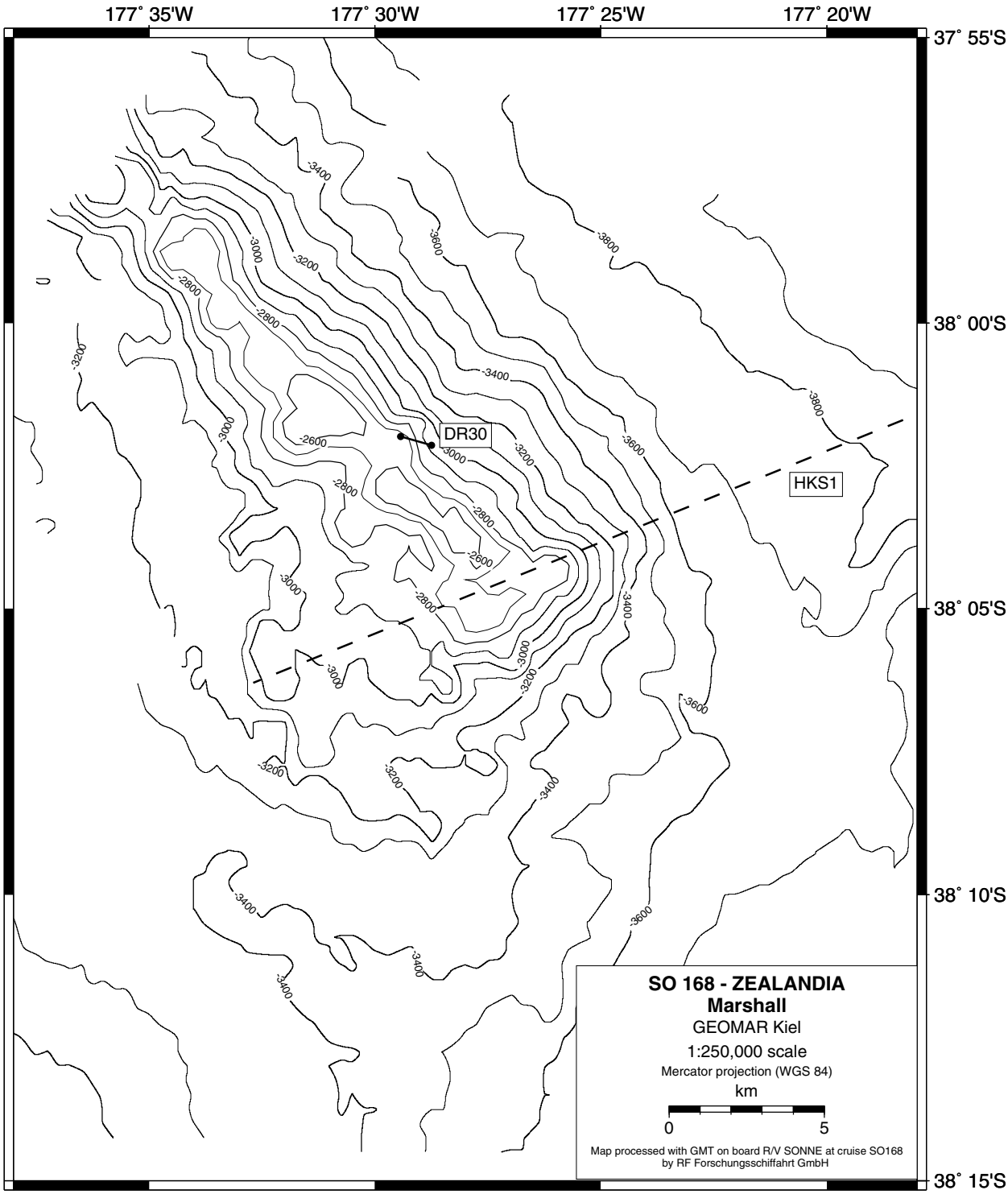

Fig. 6.14.: Bathymetric map of Marshall Ridge including locations of dredge tracks DR 30 and GNS seismic line HKS1.

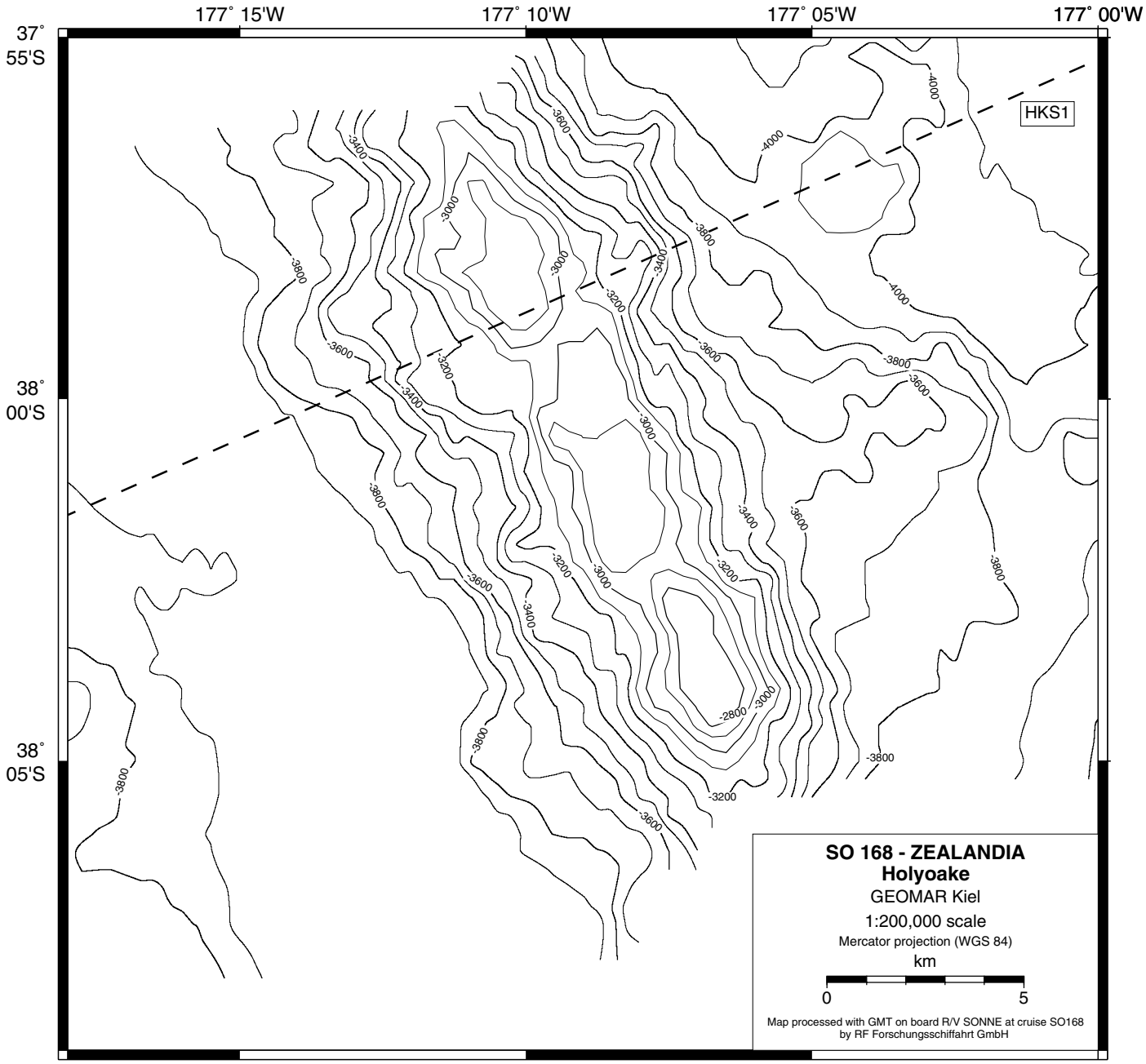

Fig. 6.15.: Bathymetric map of Holyoake Ridge including location of GNS seismic line HKS1.

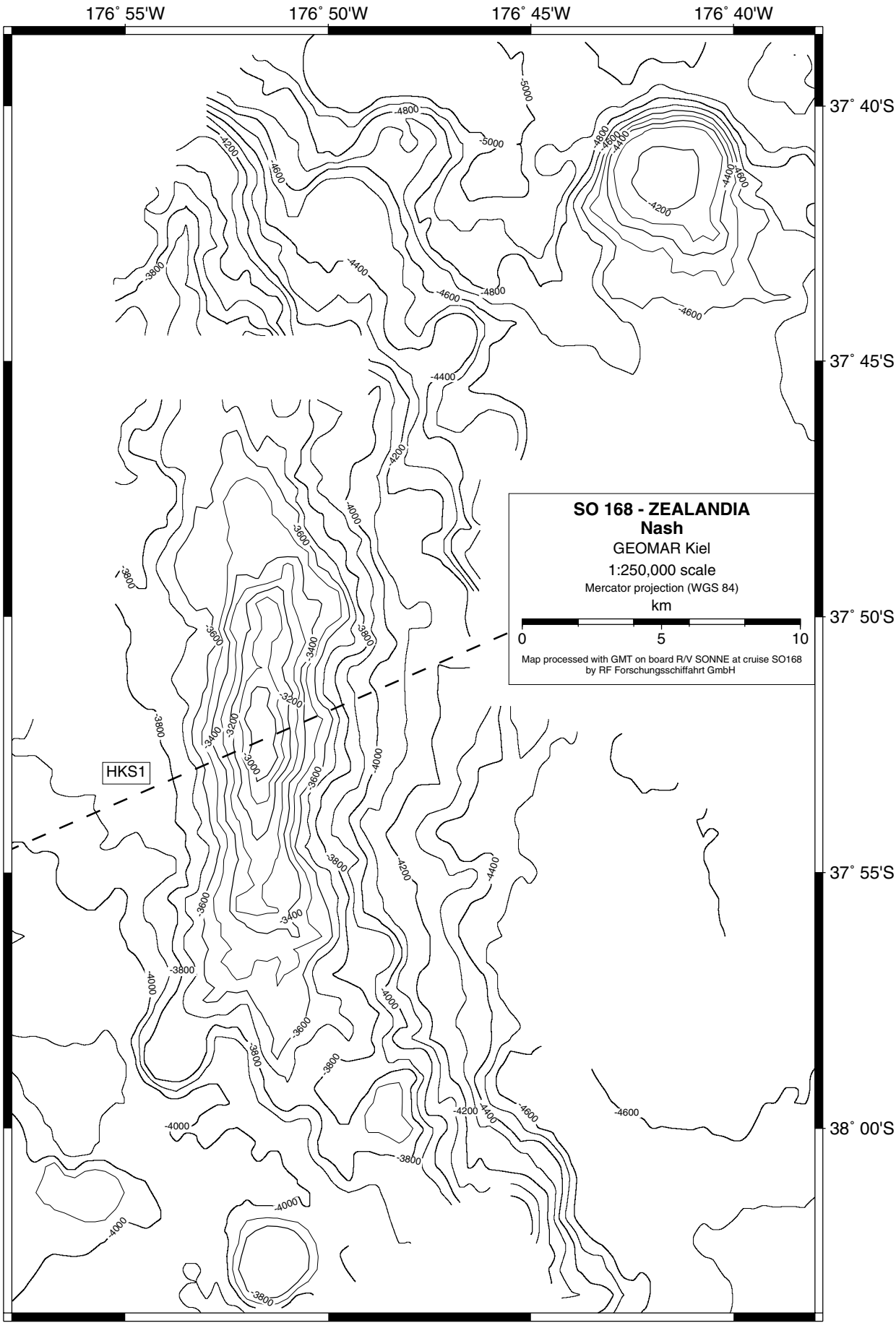

Fig. 6.16.: Bathymetric map of Nash Ridge including location of GNS seismic line HKS1.

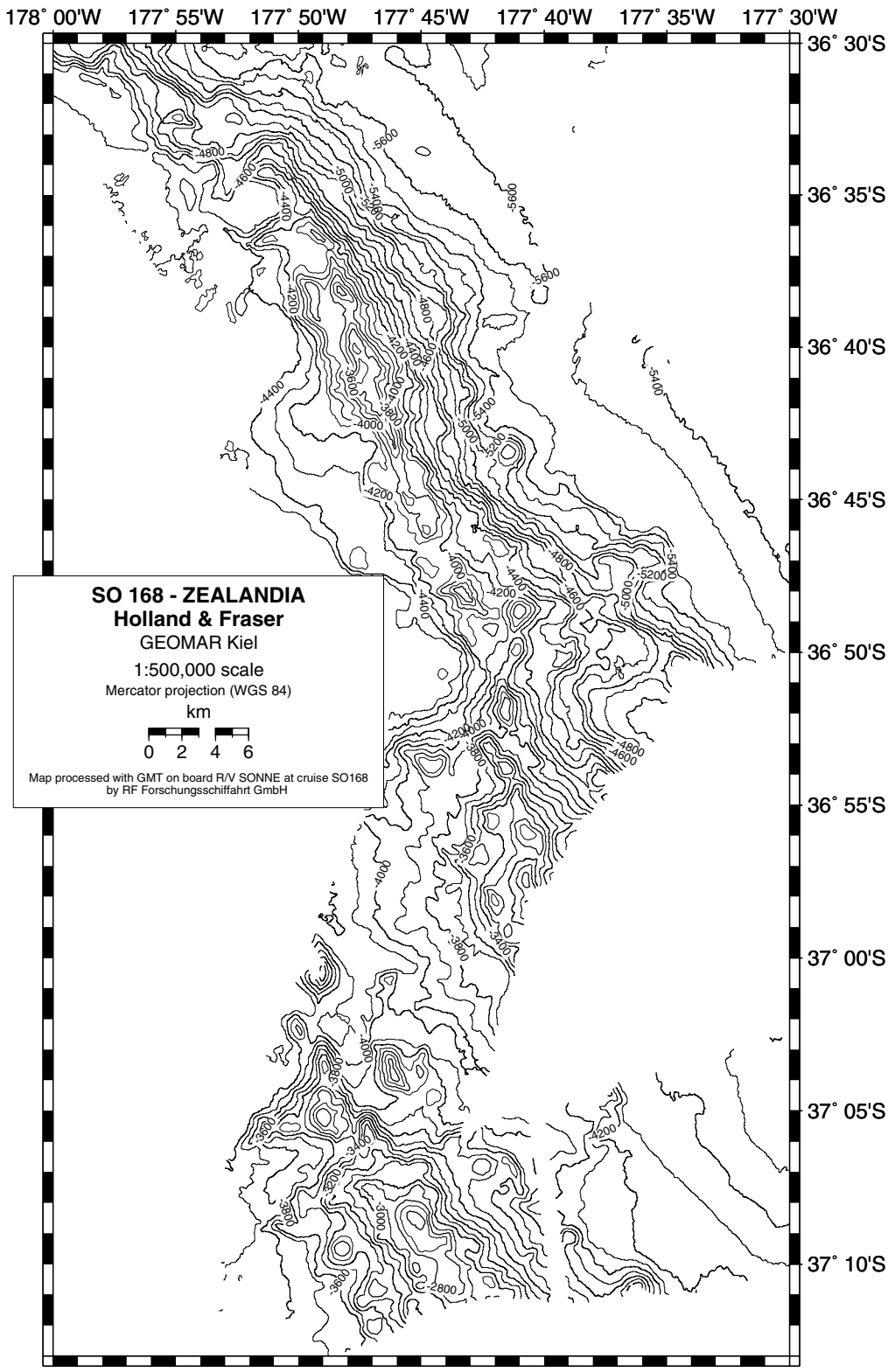

Fig. 6.17.: Bathymetric map of Holland and Fraser Ridges.

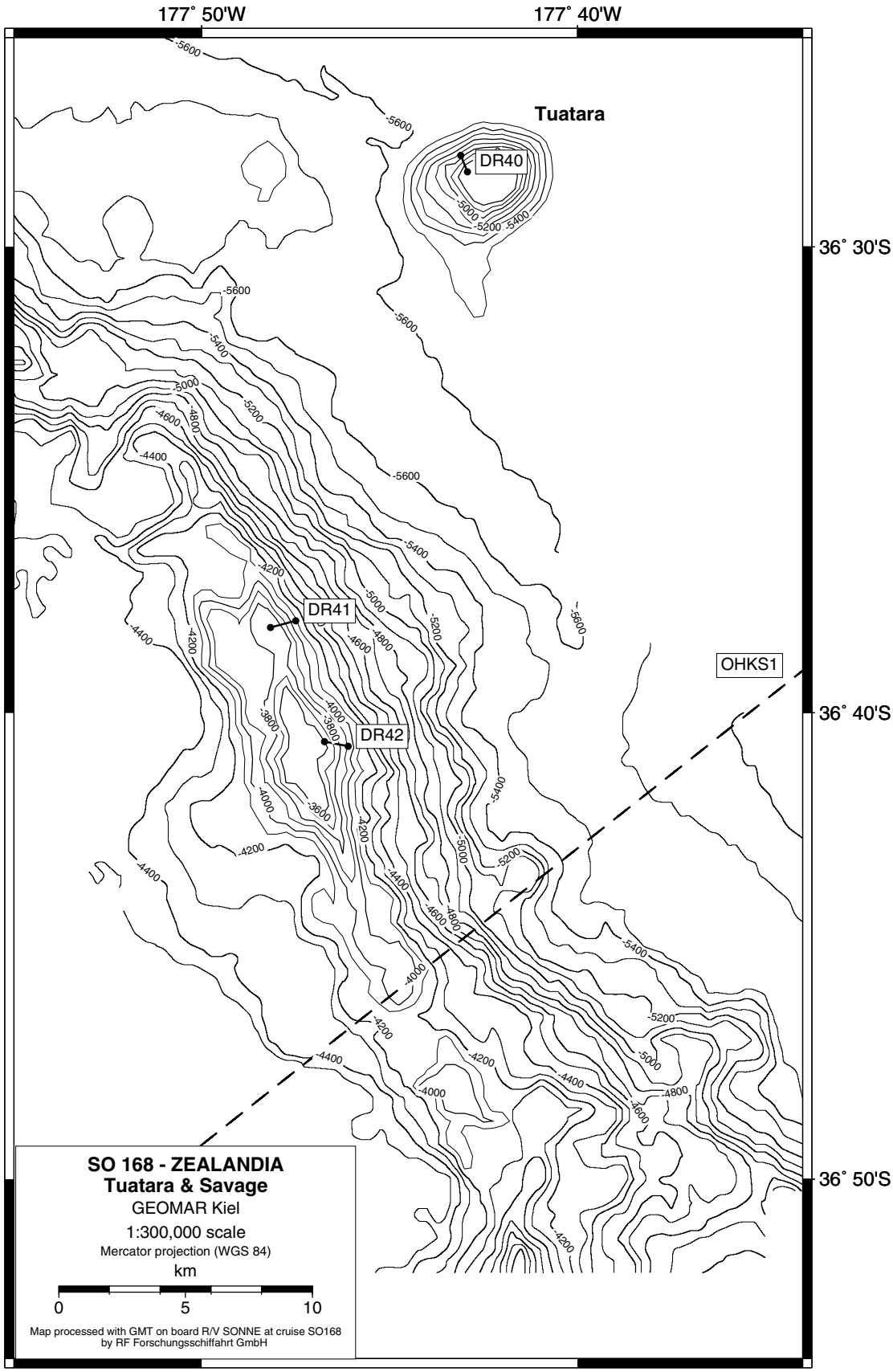

Fig. 6.18.: Bathymetric map of Savage Ridge and the small Tuatara Seamount (see also chapter 6.4.) including locations of dredge tracks DR 40 - 42 and GNS MCS line OHKS1.

the break-up of the Hikuhiki Plateau. The maximum elevation of the summits of the cones aligned to form Savage is ~3,500 m. Savage is bounded to the NE by the 5,500 m deep Hikurangi Channel on the Pacific abyssal ocean crust. Savage is bounded to the SE by the ~4,300 m deep Hikurangi Plateau. Two dredge hauls (DR 41 and 42) were carried out on Savage Ridge. They yielded thick Mn crusts and nodules, but in the cores of DR 42 were some altered amygdaloidal lavas pieces, including some palagonite that may offer the possibility of fresh glass.

Kiwi Ridge (DR 32-33)

Paper copies of RV "Atalante" swath bathymetry maps from the NZ-French GEODYNZ project (Collot et al. 1996) were made available through GNS. Initial study of this showed Kiwi Ridge to be a 45 km long linear feature, striking NNW (oblique to the Rapuhia Scarp and Hikurangi Trench). Prior to dredging and SIMRAD EM 120 mapping by SO 168, Kiwi ridge was believed to be tectonic in origin with a fault scarp on the steeper (western) side. Thus Kiwi ridge was selected as a dredge target in the belief that it would provide a section into the stratigraphically lower plateau lavas.

SIMRAD EM 120 mapping of the southernmost 22 km of Kiwi ridge actually showed it to consist of a chain of amalgamated volcanic cone-like features and the interpretation of the ridge was changed to a post-plateau volcanic ridge (Fig. 6.19.). Dredges DR 32 and 33 yielded scoriaceous and palagonitic volcanic breccias and vesicular olivine-phyric basalts, broadly similar to those obtained from Hikurangi Plateau seamounts earlier in the cruise.

Skua, Penguin and Hoiho Ridges (DR 46-47)

Skua, Penguin and Hoiho Ridges are all located on the southeastern part of the northeastern Hikurangi margin. The transit from the northwestern to the southeastern part of the plateau was made mainly across the Pacific abyssal ocean floor at 4,800 - 5,100 m depth. On the SIMRAD EM 120 track line the isobaths marking the edge of the SE part of the Hikurangi Plateau (depth change from 4,800 m to 4,400 m) trend approximately east-west. On the edge of the plateau at this point is a NNW-trending volcanic ridge (~174°20´W), Skua, whose peaks reach up to 3,700 m b.s.l. (Fig. 6.20.). Skua is also imaged on the Palmer swath line just to the north, making it ~30 km long and the only known volcanic ridge to clearly cross the Hikurangi Plateau-Pacific abyssal crust margin, indicating that it must be younger in age than the rifting event producing this margin. The gravity and TOPEX maps show the EW plateau edge trend to be just a local feature on the corner of an embayment in the NW-SE trending linear margin. The gravity map shows strong, long-wavelength anomalies trending NE-SW from the Pacific Ocean crust into the central basin of the Hikurangi Plateau. A broad slope descends north from Polar Bear to Penguin

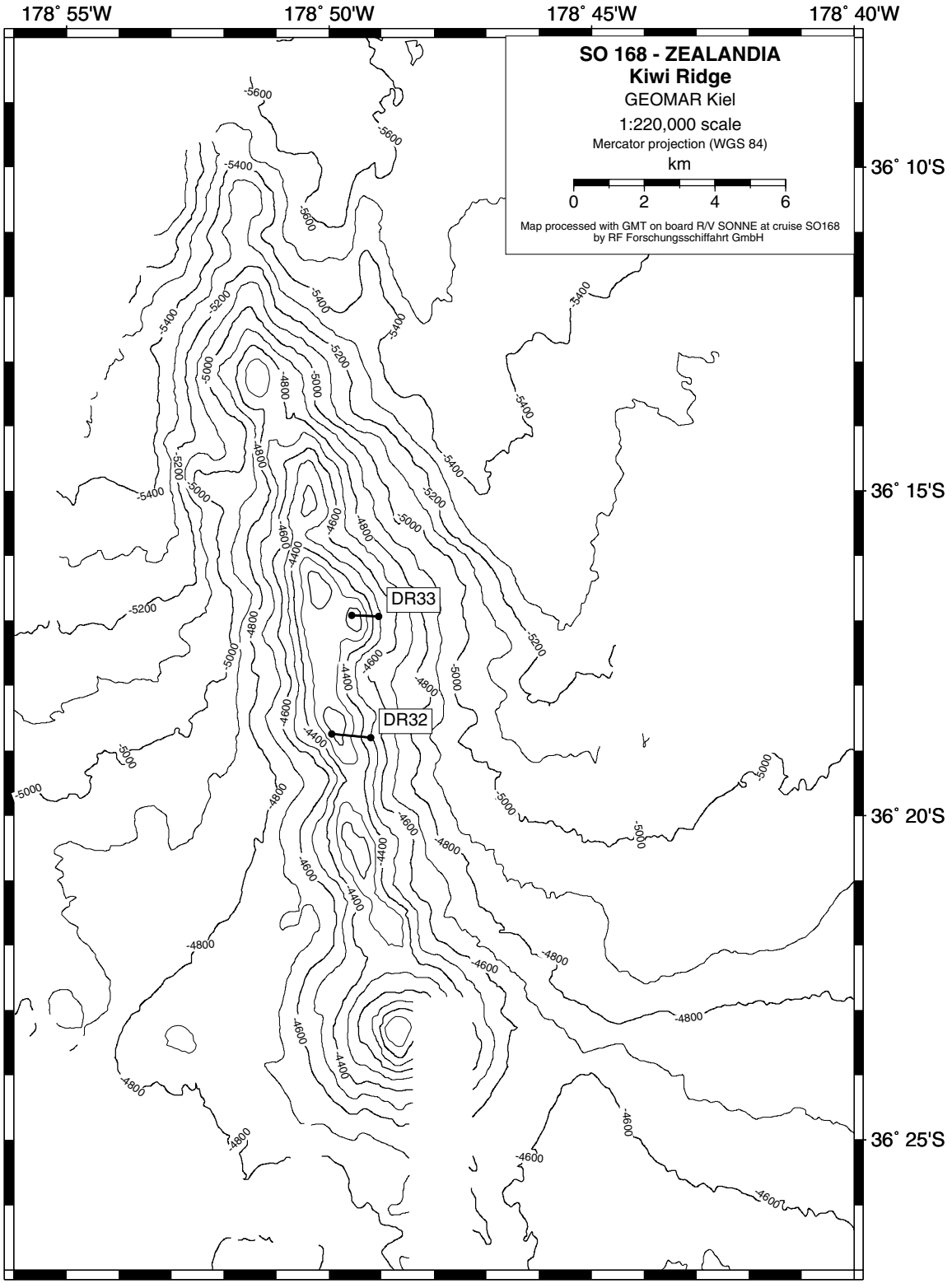

Fig. 6.19.: Bathymetric map of Kiwi Ridge including locations of dredge tracks DR 32 and DR 33.

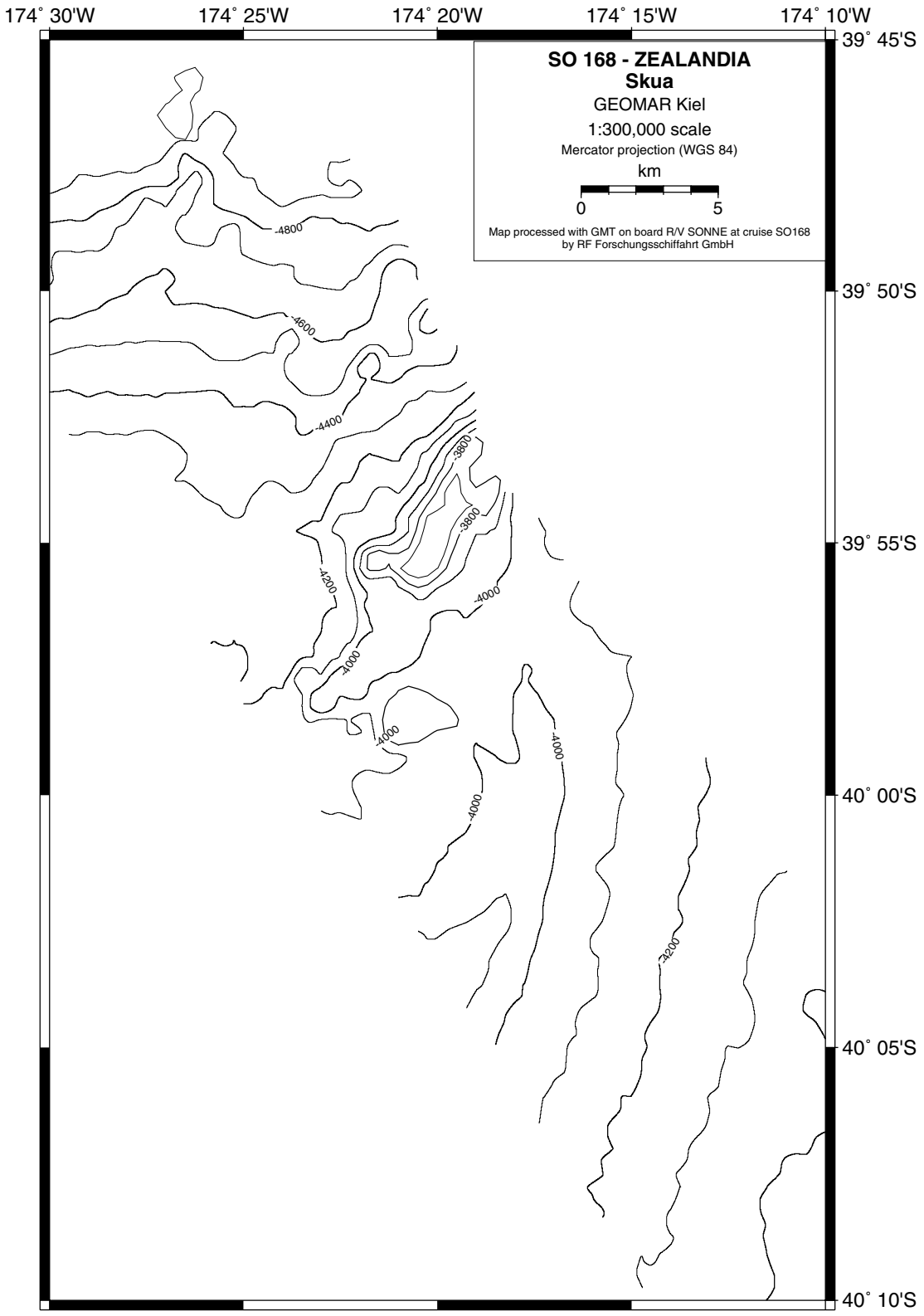

Fig. 6.20.: SIMRAD track across Skua Ridge.

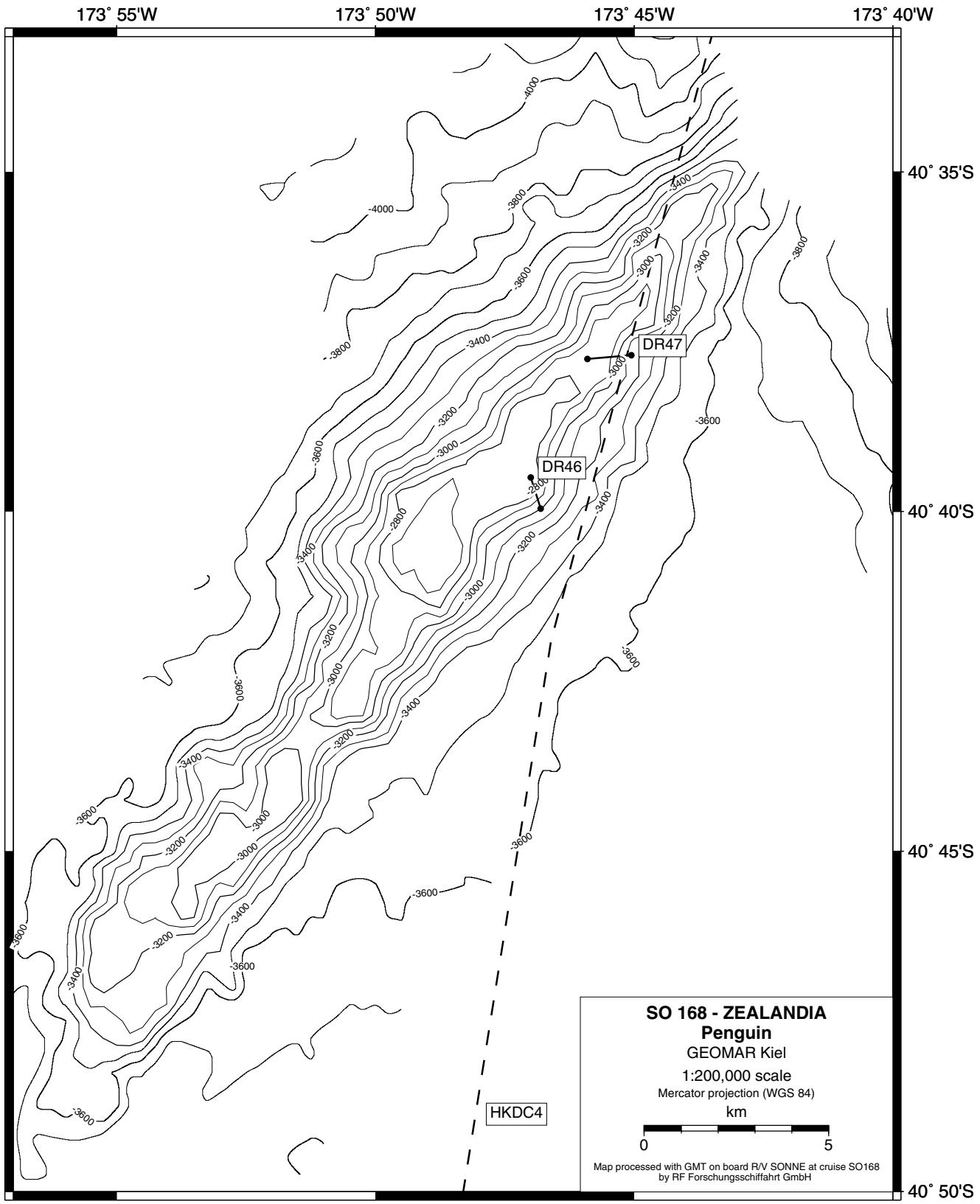

Fig. 6.21.: Bathymetric map of Penguin Ridge including locations of dredge tracks DR 46, DR 47, and GNS seismic line HKDC4.

Seamount and GNS seismic line HKDC4 was shot across this slope into the Pacific abyssal plain. A major fault in the basement, totally sediment covered, but possibly the SE continuation of the Rapuhia Scarp, is seen in HKDC4 at 39°56.1'S, 173°24.1'W.

Penguin Seamount forms a bathymetric anomaly on the TOPEX map located close to the Hikurangi Plateau margin. It forms a long (>35 km), narrow (~9 km) ridge, rising from depths of >4,300 m in the north and 3,800 m in the south to 2,600 m on its top (Fig. 6.21.). Penguin has a NNE strike of about +037°. Hoiho Seamount is located ~25 km south of Penguin and also forms a long (~15 km), narrow (<3 km) ridge with a strike subparallel to that of Penguin (+025°). A fourth (un-named) ridge between Skua and Penguin is visible on the Palmer swath line. Thus, in this part of the plateau margin there are at least four volcanotectonic ridges whose long axes trend approximately perpendicular to the main plateau edge.

Two dredges were made on Penguin (Fig. 6.21.): DR 46 sampled only Mn crusts but DR 47 yielded breccias containing vesicular olivine basalt clasts, some possibly with fresh glass. Skua and Hoiho were not sampled, only being mapped with SIMRAD EM 120 during transits. At a future date, it would be useful to integrate swath data from the NW-SE Palmer transit with the SO 168 SIMRAD EM 120 data. The two transits are subparallel and between them it would allow better definition of Hikurangi Plateau edge features.

Summary

Seamounts along the edge of the plateau differ markedly in their morphology from those within the plateau. In contrast to the guyot-shaped interior seamounts (steep-sided, circular structures with flat tops), the marginal seamounts form ridge-like structures commonly sub-parallel to the Rapuhia Scarp, suggesting that they formed along extensional faults. Some of the ridge-like marginal seamounts (e.g., Savage, Nash, Penguin) are present right at the plateau boundary, whereas others (e.g., Marshall) are more than 65 km from the Rapuhia Scarp. These linear volcanic structures suggest that multiple, subparallel extensional faults, possibly related to Hikuhiki Plateau breakup and rifting, are not restricted to just the margins of the plateau.

The ridge-type seamounts reach elevations of up to 1,500 m above the sea floor, which exceeds the height of the erosional platforms above the sea floor on the guyots (850 - 1,225 m), but is similar to the elevations of the post platform volcanism on the guyots (up to 1,650 m above the sea floor). Therefore at least the latest stages of volcanism on some of the ridge-type volcanic seamounts formed after the interior seamounts were eroded to sea level and began to subside. In contrast to the non-vesicular nature of the plateau lavas highly vesicular olivine basalts were recovered from the ridge-like seamounts, similar to those from the post-platform volcanics on the guyot seamounts.

6.3.3. Rapuhia Scarp

The Rapuhia Scarp, up to 1.000 m high, marks the northeastern margin of the Hikurangi Plateau It can be traced from the Kermadec Trench to 38°40´S and 176°W and, with increasing difficulty due to sedimentary burial, south from this point towards the Chatham Rise. The sracp is linear and sharp along its northernmost 150 km and become fragmented further south (Davey and Wood 1994). Gravity models across the scarp show that the basement boundary is abrupt and extends through the crust (Davy 1993, Davy and Wood 1994, Wood and Davy 1994). One dredge haul carried out at the mid-portion of the Rapuhia Scarp on RV "Rapuhia" cruise HP9106 (dredge HP9106-2) yielded about 30 kg of unfossiliferous, highly-weathered (smectite-rich) volcanic and volcaniclastic rocks. Mortimer and Parkinson (1996) showed that these rocks were similar to basalts from the Ontong Java and Manihiki Plateaus (Jackson et al. 1976, Berger et al. 1991, Mahoney and Spencer 1991, Mahoney et al. 1993); the least-altered lavas (only 3 samples with <15% clay) had MORB-like major and trace element concentrations but ocean island-like Sr and Nd isotopic ratios. Despite a relatively restricted range in Sr and Nd isotope ratios, Pb isotope ratios vary widely ($^{206}Pb/^{204}Pb$ = 18.9-21.0, leached residues of 3 samples) and are interpreted by Mortimer and Parkinson (1996) to reflect the presence of a phase in the residue with very high $^{238}U/^{204}Pb$ ratios. Since the $^{238}U/^{204}Pb$ ratios of the residues were not determined, the data cannot be age corrected and “cannot be used to infer characteristics of the mantle sources” (Mortimer and Parkinson 1996).

Rapuhia Scarp (DR 34, 36-39, 44-45)

The Rapuhia Scarp was considered the best place at which a stratigraphic section into the constructional lava pile of the Hikurangi Plateau could be obtained – in contrast to sampling seamounts subsequently constructed on the plateau. GNS seismic lines OHKS1a, HKS2ab, HKS1bc and HKDC1, the RV “Atalante” swath map, plus SIMRAD EM 120 mapping from the Christmas transit between Marshall Seamount and Kiwi ridge, allowed the nature of the margin and a number of dredge targets to be selected. Unsurprisingly, the scale and detail of SIMRAD EM 120 mapping revealed the margin between the Hikurangi Plateau and the adjacent Pacific ocean crust to be more complicated than the simple single Rapuhia Scarp described by Wood and Davy (1994) and indicated on regional gravity and bathymetry maps. The volcanic ridges of Kiwi, Muldoon and Savage have already been described; across these ridges there is a change in elevation of a few hundred metres between the Hikurangi Plateau and the abyssal ocean crust of the Pacific plate.

Where there are no volcanic ridges, the plateau edge is generally defined by a major fault, the Rapuhia Scarp (Fig. 6.22.). North of 36°30'S, the scarp is a single linear feature, trending 135°

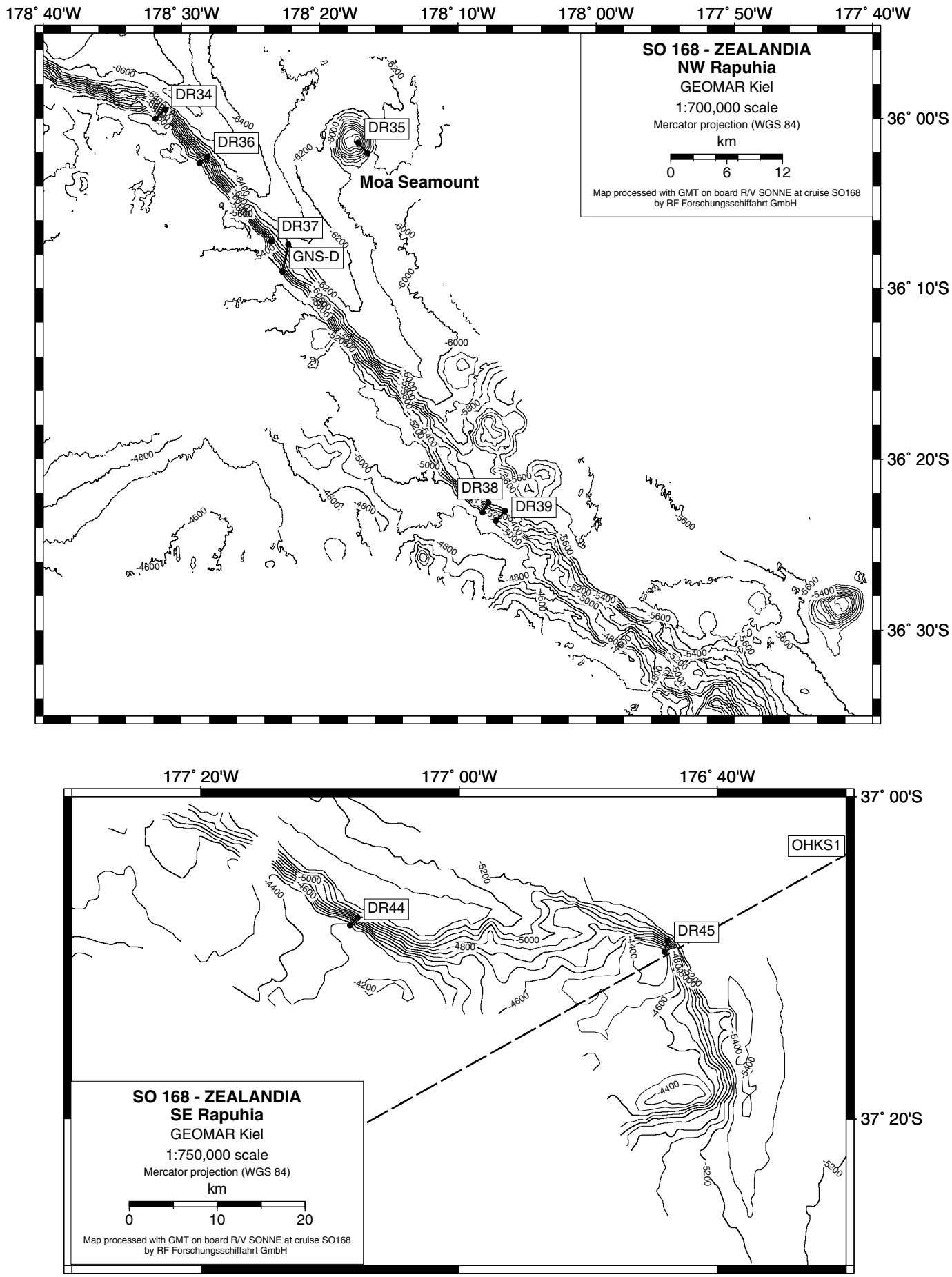

Fig. 6.22.: Bathymetric maps of the Rapuhia Scarp including locations of dredge tracks DR 34 - 39, 44 and 45, GNS dredge HP9106-2, and GNS seismic line OHKS1.

South of here, the margin steps in and out with displacement taken up on subparallel subsidiary faults, revealed through stepped terraces above the Hikurangi Channel. Fault slope angles generally do not exceed 35°. The greatest vertical height of a single fault scarp was ~800 m.

The dredges on the Rapuhia Scarp (DR 34, 36-39, 44, 45) were some of the deepest made on the cruise (4,280 - 6,182 m). They yielded a suite of igneous rocks similar to the sole existing volcanic dredge on the Hikurangi Plateau (Mortimer and Parkinson 1996), and were noticeably different from samples recovered from the Hikurangi Plateau seamounts. Igneous rocks were non-scoriaceous, non- to sparsely amygdaloidal aphyric, equigranular cpx-plagioclase basalts, dolerites and gabbros. Sea floor weathering, to clay and zeolite-bearing assemblages was moderate to intense. Of the seven dredges made, DR 34 and DR 39 contained the freshest and most useful for petrologic analysis and radiometric dating; the most weathered material in DR 34 is fresher than the freshest rocks in DR 36. DR 37 contained only sedimentary rocks. DR 38 was dominated by volcaniclastic rocks but contained a few basalts/dolerites only two of which are relatively unweathered enough for analysis. Small fresh kernels of two non-amygdaloidal olivine basalts in DR 39 are of good quality for analysis and this dredge also contained a boulder of hyaloclastite lapilli tuff with prominent dark red palagonite clasts which appear to contain fresh glass. DR 44-45, on the southeastern part of the Raphuhia Scarp, yielded breccias and sandstones with no analysable lavas.

Summary

The Rapuhia fault scarp forms the northwestern boundary between the Hikurangi oceanic plateau and the deeper normal oceanic crust (abyssal plain). It exposes the upper portions of the plateau for direct sampling. Samples were recovered from six localities along the scarp at depths of 4,300 to 6,200 m. Igneous samples included non to slightly vesicular cpx-plagioclase and olivine basalts, dolerites, gabbros, and hyaloclastites, some with what appears to be fresh glass. Sedimentary rocks (sandstones) and Mn-Fe oxides were also recovered. The SIMRAD EM 120 mapping at many locations showed that, on a km scale, a single, simple Rapuhia Scarp does not exist. We suggest that the term Rapuhia Scarp be reserved for the northwesternmost part of the plateau margin where a single fault does appear to exist. The steep, faulted margin of the Hikurangi Plateau is stepped both vertically and laterally. It is marked by several subparallel, fault strands which appear to vary in throw along strike and which have been overprinted by volcanic ridges such as Savage.

6.3.4. Hikurangi Plateau Summary

Two types of seamounts were mapped and sampled on the Hikurangi Plateau: (1) large guyot-type seamounts with circular, steep-sided bases and relatively flat tops, which occurred primarily within the plateau, (2) ridge-type volcanic seamounts which occurred primarily along the northeastern margin of the plateau. The guyot-type seamounts are believed to represent the last stage of volcanism in the formation of the Hikurangi Plateau and to have formed over a relatively short time interval, possibly a few million years. These volcanoes originally formed islands which were eroded to sea level as the plateau began to subside during the waning stage of plateau formation. Late stage (post-erosional) volcanism formed on the erosional platforms after they subsided below sea level. The ridge-type volcanoes appear to be associated with faulting along the northeastern margin of the plateau, most likely related to the rifting apart (break-up) of the combined Hikurangi-Manihiki (Hikuhiki) Plateau. The ridge-type seamounts are higher than the erosional platforms on the guyot-type seamounts and show no signs of subaerial erosion. Therefore they must have been active after the erosional platforms had subsided well below sea level and may be similar in age to the post-erosional volcanism on the guyots. After break-up of the Hikuhiki Plateau, the Hikurangi Plateau continued subsiding, with the net effect that the northern part of the northeastern boundary underwent the most subsidence, such that the Hikurangi Plateau is presently tilted downwards to the NE (at least 3,300 m in the northwest compared to 1,600 m in the southwest and at least 2,200 m in the east). Age dating of samples from the plateau and the guyot- and ridge-type seamounts on the plateau will allow us to determine the age of the Hikurangi Plateau and to constrain the age of the break-up event.

6.4. PACIFIC OCEAN CRUST SEAMOUNTS NEAR RAPUHIA SCARP

Moa, Tuatara and Kiore were three of four possible dredge targets chosen to sample seamounts on the Pacific ocean crust adjacent to the Hikurangi Plateau. These should provide minimum ages of the ocean crust adjacent to the plateau thereby helping to constrain the age of rifting at the plateau edge and, in conjunction with SO 167 sampling of the Osborn Trough, to constrain spreading rates in the Cretaceous ocean crust north of the Hikurangi Plateau.

Moa Seamount (DR 35)

Moa is visible on the GEODYNZ swath map, but is too small to appear on gravity or TOPEX bathymetric maps. GEODYNZ and SIMRAD EM 120 swath mapping revealed Moa to be a 5 km diameter symmetrical cone, some 11 km distant from the Rapuhia Scarp. It rises ~800 m above the 6,200 m deep abyssal plain; no summit crater is evident (Fig. 6.23a.). Steepest slopes on Moa are ~32°. A single dredge on Moa gave ~450 kg of spheroidally jointed and

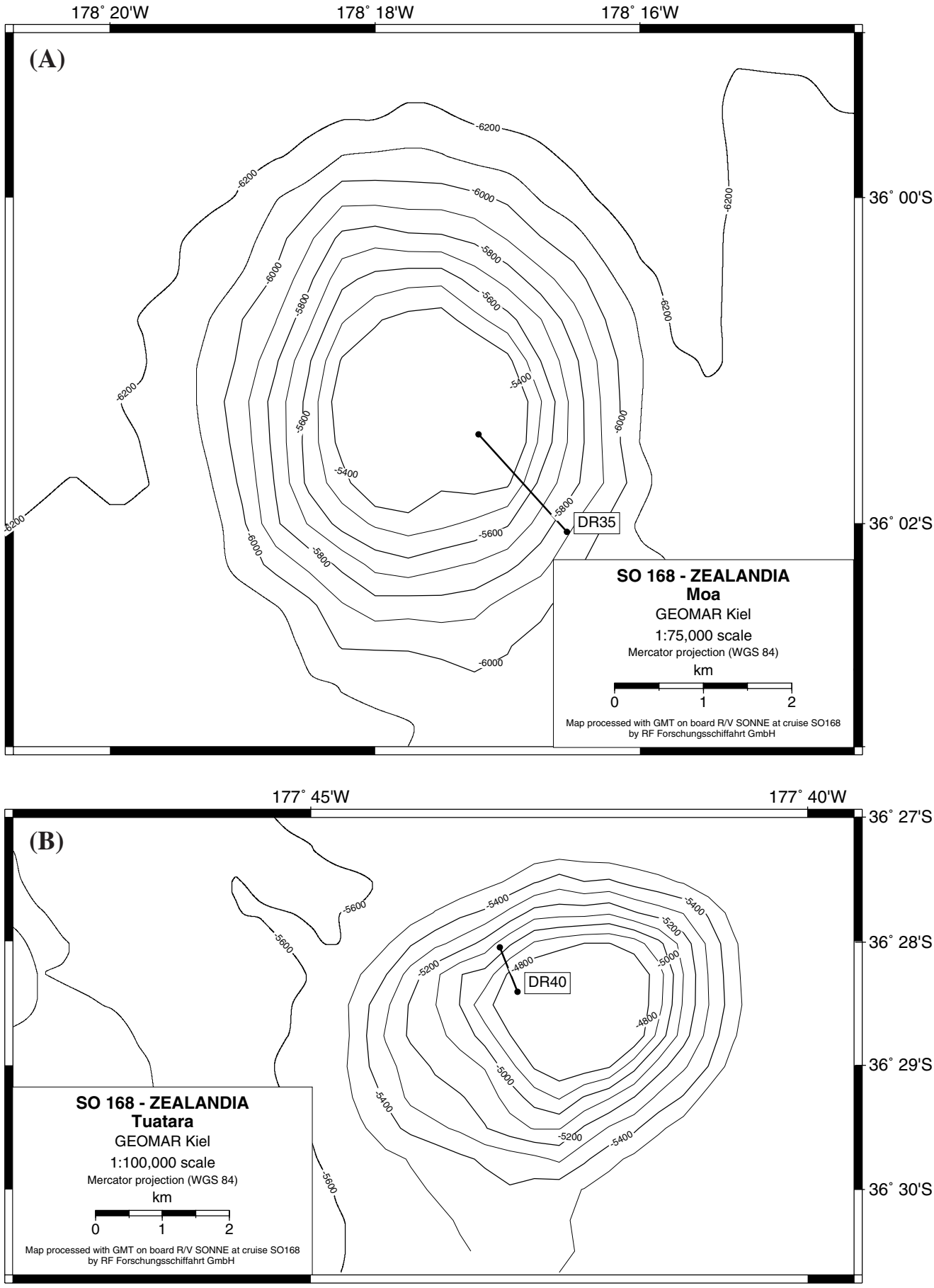

Fig. 6.23.: Bathymetric maps of (A) Moa Seamount and (B) Tuatara Seamount including locations of dredge tracks DR 35 and DR 40 (for Tuatara Seamount compare 6.22).

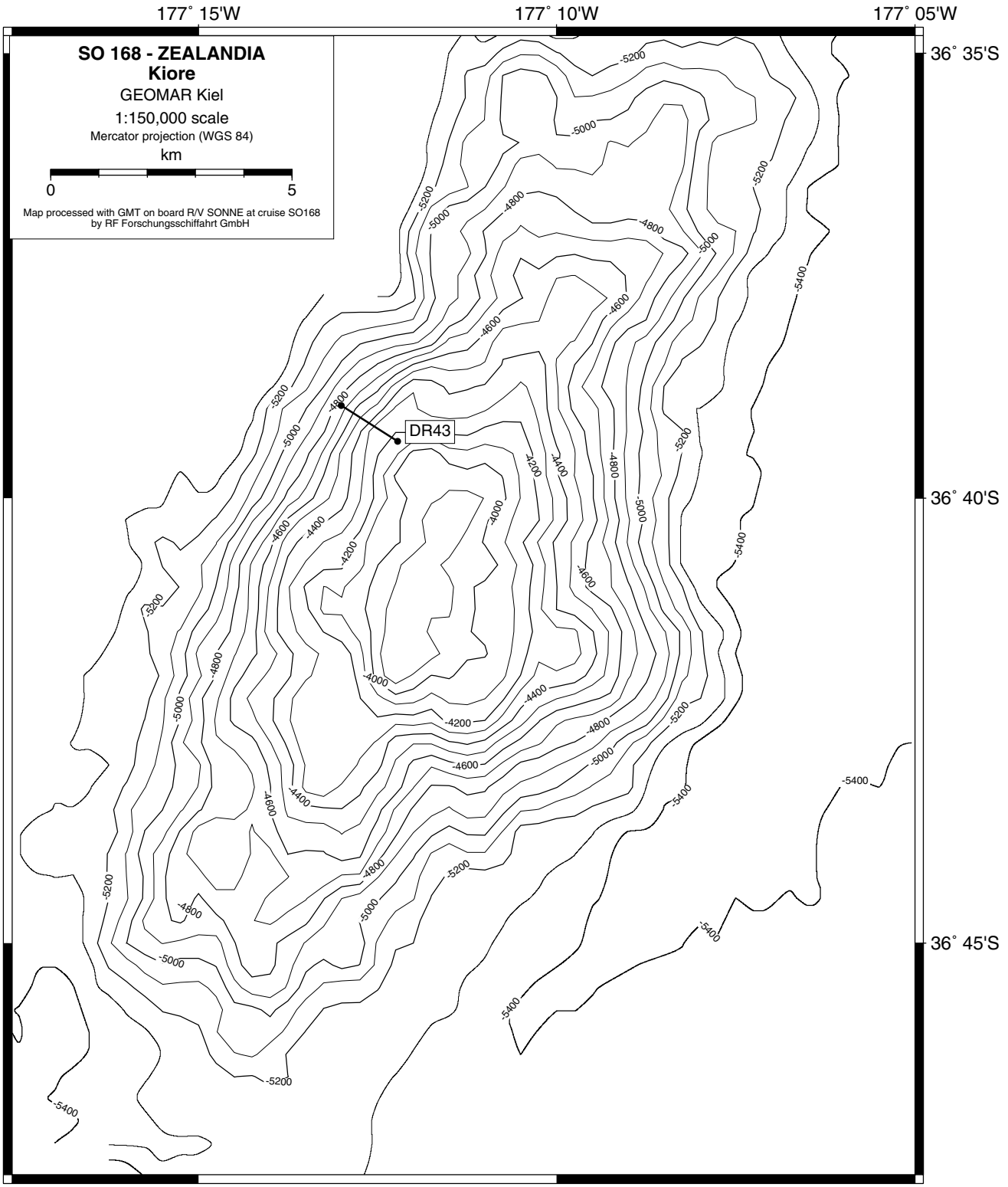

Fig. 6.24.: Bathymetric map of Kiore Seamount including location of dredge track DR 43.

hydrothermally altered lavas with a serpentine-like mineral replacing basalt. There were no associated breccias. A few fresh cores of the joint blocks are monotonous black, pyroxene-phyric basalts. All samples are very similar.

Tuatara Seamount (DR 40)

Tuatara appears on the Palmer-9601 swath line and, like Moa, is also too small to appear on regional gravity and bathymetry maps. Tuatara is ~20 km in diameter, and is slightly elongated with gentler slopes on its SW side. It rises 900 m above the 5,600 m abyssal plain and has a flattish top (Fig. 6.23b.). A single dredge on Tuatara (DR 40) gave pale green-grey medium-grained basalts/dolerites with probable chlorite-actinolite assemblages. Feldspar in the samples appeared fresh enough for dating. The Tuatara material is quite different from Moa and is similar to the Rapuhia Scarp basalt/dolerite suites.

Kiore Seamount (DR 43)

Kiore is larger than Moa and Tuatara and appears on the TOPEX and satellite gravity maps. It measures some 16 x 9 km at the base, and is approximately 1,600 m high (Fig. 6.24.). Its elongation in a NNE direction marks it as different from both Moa and Tuatara and from the other volcanic ridges (e.g., Savage, Nash) on the edge of the Hikurangi Plateau. The azimuth of 025 is approximately parallel to the expected direction of rifting between the Hikurangi Plateau and Osborn Trough spreading center, as revealed by putative fracture zones. A single dredge on Kiore (DR 43) gave fresh, aphyric, vesicular basalts.

Summary

One ridge-type and two conical volcanic seamounts on the Pacific abyssal sea floor between 12-48 km from the Rapuhia scarp were sampled. Seismic data from a seamount on the ocean crust south of Kiore shows that it is located directly on the magmatic part of the seafloor (beneath the entire sediment pile). Therefore the sampled seamounts are likely to give us a good estimate of the age of the ocean crust adjacent to the Hikurangi Plateau – the oldest crust formed at the now extinct Osbourn Trough spreading center. Age dating of these seamounts will allow us to place further constraints on the age of the break-up of the Hikuhiki Megaplateau.

6.5. EASTERN CHATHAM RISE AREA

The eastern Chatham Rise area is defined as that part of the axial Chatham Rise below 1,500 m water depth (approximately east of longitude to contain the eastern Chatham Rise as well as seamounts to the north [including the Wishbone Ridge] and seamounts to the south [within 40°S-47°S and 167°W-174°30‘W]). As with the Hikurangi Plateau margins, some existing swath bathymetric data and seismic lines were able to be used to identify targets for dredging. The

magnetic map of New Zealand (Sutherland 1996) only extends as far east as 172°W so there were no magnetic data available for most of the SO 168 Eastern Transect. The expectation was that the Wishbone Ridge would provide samples of Pacific Ocean crust (MORB) and that the seamounts to the SE would be intraplate alkali basalt seamounts on abyssal ocean crust related either to a westward continuation of the Osbourn Trough spreading center (see Fig. 4.1.), or to the initiation of pre-84 Ma spreading on the Pacific-Antarctic Ridge, i.e. rifting of Zealandia from Marie Byrd Land Antarctica. The mapped and sampled seamounts are of three kinds: ridges, guyots and tilted fault blocks.

6.5.1. Northern Rifted Margin

Wishbone Ridge (DR 54-56)

On satellite gravity maps of the SW Pacific Ocean, the Wishbone Scarp/Ridge is a forked 1,300 km long gravity feature, the western part of which has been interpreted as a Cretaceous transform fault between the Osbourn Trough spreading center and the NE margin of the Hikurangi Plateau (Billen and Stock 2000, Sutherland and Hollis 2001). As part of the NZ Continental Shelf Program (CSP), GNS multi-channel seismic (MCS) line HKDC9B was shot subparallel to the Wishbone gravity anomaly, and a portion of the Wishbone feature was swath mapped. This work defined a complex system of NE-trending sharp, fault-like ridges extending at least 150 km from the 3,700 m base of the gentle eastern Chatham Rise (continental?) slope and lying within a linear negative gravity anomaly. The Wishbone ridge segments is thus defined as a rise from a featureless abyssal plain at 4,000 - 4,500 m depth. It was decided to target the highest and steepest, 53 km long, ridge segment for SIMRAD EM 120 mapping and dredging.

SIMRAD Em 120 mapping was done over the southern two thirds of the ridge segment (Fig. 6.25.). The ridge is flat-topped and is at ~2,500 m depth at its SW end and ~2,900 m at the NE end of the SO 168 survey. This decrease in elevation is almost matched by the gradient in the abyssal plain in the same direction from 4,300 to 4,700 m. The ridge segment lacks the clear individual and coalesced cone-like shapes that characterise most of the volcanic ridges on the Hikurangi Plateau. The steep (up to 41°) and linear slopes on the dredged (SE) side of the ridge support modification by faulting. The planar top is strongly suggestive of wave erosion followed by subsidence, similar to that inferred for guyots.

Dredges DR 55-56 contained moderately fresh grey feldspar porphyritic lavas and ?shallow intrusives, of possible dacitic composition. Silicic igneous rocks with no associated basalts are not expected in an intraoceanic setting. Preliminary interpretation of this part of the Wishbone Ridge is of a continental fragment that was either stranded there during rifting or has been tectonically shuffled into position (fault sliver). DR 54 and 55 contained feldspathic lithic

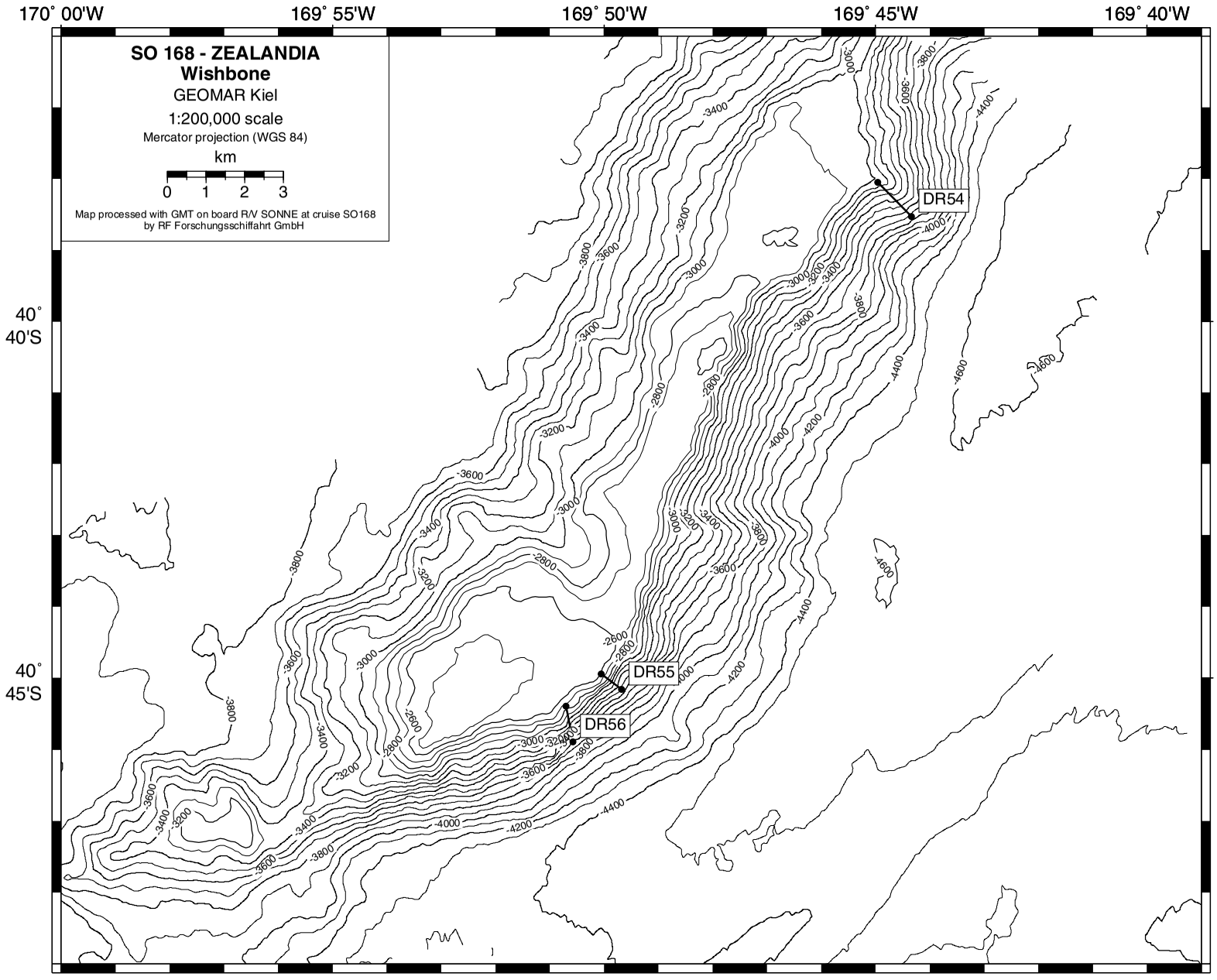

Fig. 6.25.: Bathymetric map of a ridge segement in the southern part of Wishbone Scarp/Ridge including locations of dredge tracks DR 54 and DR 56.

sandstones, possibly derived from the local igneous rocks, or of continental derivation. The flat top of Wishbone possibly indicates a simple model of isolated erosion near wave base followed by subsidence, like the aforementioned guyots. Alternatively, the presence of abundant sedimentary rocks in the dredges may support a flat sedimentary cap that was formerly more extensive. Tectonic reasons aside, the gravity low in this part of the Wishbone Scarp may be partly explained by the low density, silica-rich rocks contrasting with surrounding ocean crust basalts. Some cataclastic lavas were also present in DR 56, consistent with a faulted SE scarp of this part of the Wishbone Ridge.

Chicken Guyot (DR 57)

Chicken Seamount has a large positive gravity anomaly, comparable to Polar Bear, and is very steep sided. Existing swath mapping and seismic line OCR2 suggested that it was suitable for dredging.

SIMRAD EM 120 mapping was done only to locate a suitable dredge site (Fig. 6.26.). Chicken Seamount is a guyot, 16 km in diameter at its 4,500 m base, rising to a flat top at 2,000 m. This makes it the highest (base to top) guyot mapped on the cruise. Two small 100 m cones are visible on the flat top as is a volcanic ridge extending 6 km ENE from the guyot. Available mapping indicates that Chicken appears to have suffered no post-volcanic tiliting or faulting, although Palmer bathymetry reveals two linear ridges between Chicken and Pukeko (to the south) seamounts that do appear fault controlled. Dredge DR 57 on the eastern slope of Chicken yielded a large quantity of highly altered, multi-colored, aphyric, subtrachytic-textured lavas, possibly basalts, but perhaps more likely to be intermediate lavas. Smaller quantities of fresher plagioclase porphyritic ?dacites, similar to the Wishbone igneous samples and volcanic breccias were also obtained.

Pukeko Ridge (DR 58)

This 12 x >25 km ridge-type seamount has a positive gravity anomaly, but smaller than that of Chicken. Palmer swath mapping and GNS seismic line CR5 suggested that its eastern slopes were suitably steep for dredging. Pukeko was not completely surveyed with SIMRAD EM 120 (Fig. 6.27.) but it is distinctly elongated in a NNE direction (strike of 25°) and is along strike from the aforementioned linear ridges between Pukeko and Chicken. It rises to elevation of 2,300 m and is 2,100 m above the abyssal plain, which is at 4,400 m b.s.l.. Pukeko apparently lacks a planar top and is 300 m lower than Chicken, perhaps indicating it never reached sea level.

One dredge, DR 58 yielded 500 kg of subangular boulders of moderately platy, non- to slightly vesicular aphyric intermediate lava, i.e. somewhat similar to most of the lavas from Chicken.

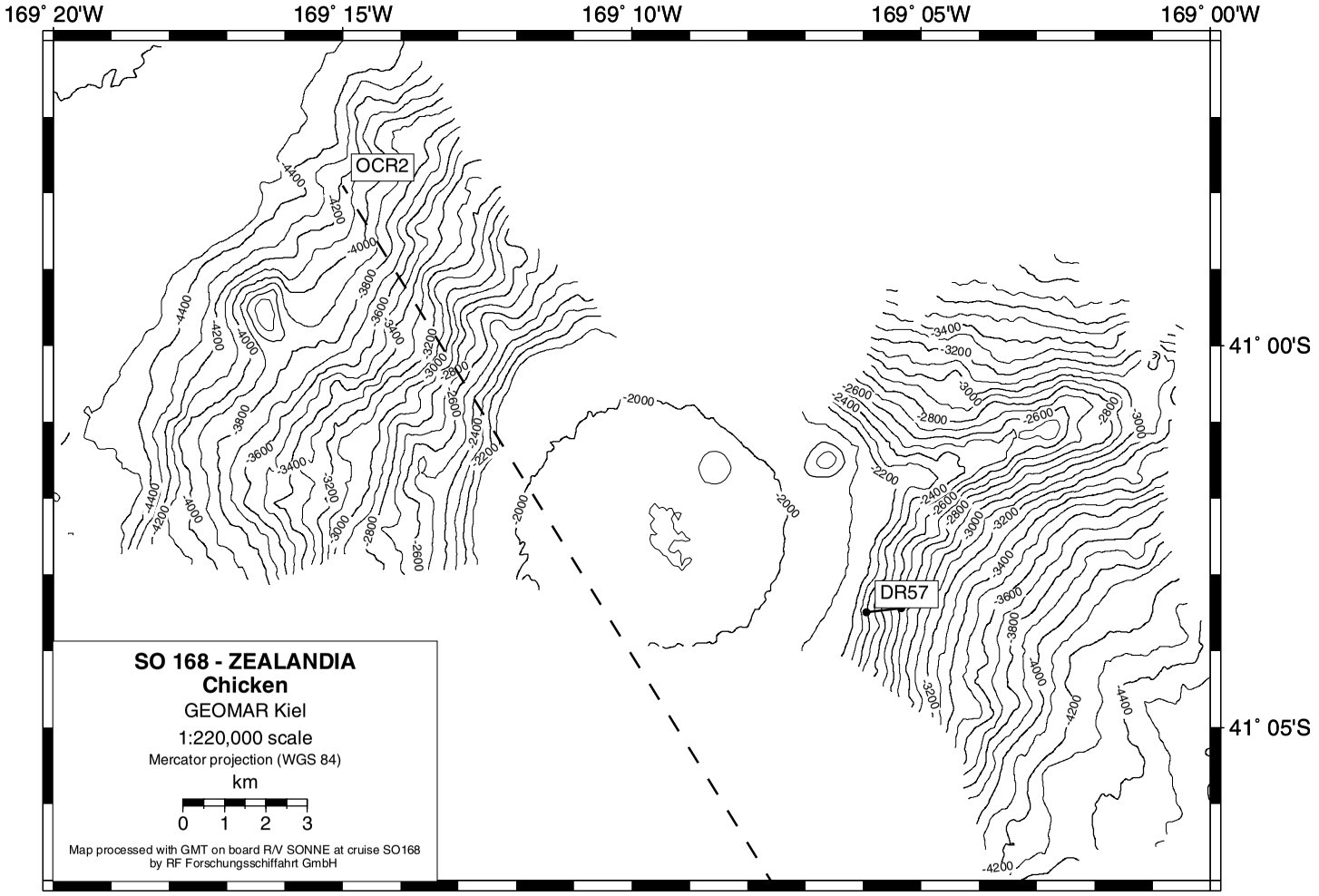

Fig. 6.26.: SIMRAD track across Chicken Guyot including locations of dredge track DR 57 and seismic line OCR2.

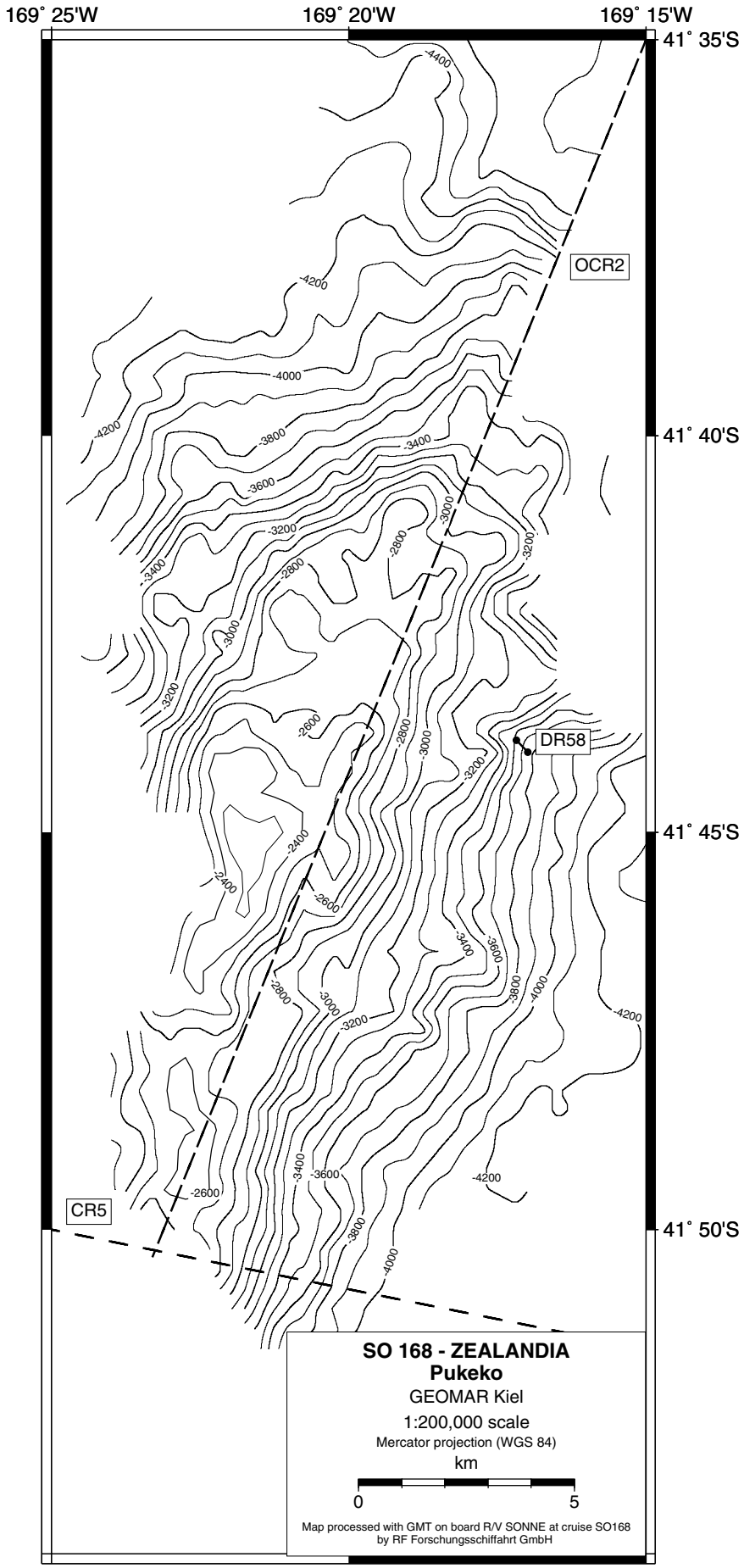

Fig. 6.27.: Bathymetric map of Pukeko Ridge including locations of dredge tracks DR 58 and seismic lines OCR2 and CR5.

6.5.2. Central Rise

Weta Guyot (DR 59-60)

The Weta guyot shows up on the regional TOPEX bathymetry and gravity maps. The bases of Chicken and Pukeko are at 4,400 - 4,800 m on the abyssal oceanic plain but Weta Seamount is much higher, on the final broad 2,700 - 3,200 m rise before the crest of the Chatham Rise at 2,500 m. On GNS seismic line CR5, a group of small, 300 - 400 m high cones are shown to the NNE of Weta Seamount. On the Palmer swath bathymetry map, they appear to be linear alignment of cones.

SIMRAD EM 120 mapping showed that the cones were part of a constructional volcanic rift arm trending 020° away from the Weta shield volcano, which has an erosional platform located at 2,200 m water depth (Fig. 6.28.). The erosional platform is only 600 m above the sea floor to the south located at 2.800 m water depth. Taking into account a sediment thickness of 300 - 400 m (GNS seismic line CR5), the easternmost Chatham Rise, similar to the western Chatham Rise, appears to have been shallower than 1,000 m water depth in the past. Two different cones on the NNE rift arm were dredged. DR 59, on the largest cone, gave moderately fresh amygdaloidal olivine basalts. DR 60 gave a volcanic breccia, very altered with much Mn-Fe oxide, but containing broadly the same lava type as DR 59. Despite being on the same N-S transect, it is possible that the Weta lavas are much younger and petrologically unrelated to those from Chicken, Pukeko, Takahe and Kakapo.

Takahe Fault Block (DR 62)

Takahe is on the south side of the Chatham Rise, ~80 km south of the Weta seamount. It is located ~50 km south of the main axis of the Chatham Rise. Downslope from Takahe is the Southern Ocean which is still opening along the present day Pacific-Antarctic spreading ridge. Takahe lies just north of the northernmost gravity low (of –20 mgal) that might be associated with the presence of abyssal ocean crust adjacent to a rifted continental margin. However, the nature of the crust underlying the eastern end of the Chatham Rise (magmatically or tectonically thickened oceanic, or rifted continental) is somewhat speculative. Unlike most other seamounts of its size, Takahe has only a low, broad positive gravity anomaly of +20 mgal. Takahe presented a low, gentle, unattractive-for-dredging profile on GNS seismic line CR2. Out-of-profile reflections made geological interpretation difficult, but its flat top seemed to have a south-dipping thin sedimentary cover.

SIMRAD EM 120 mapping showed Takahe to be a broad elongate low plateau with a top at 2,400 - 2,600 m (Fig. 6.29.). The plateau has an irregular ~20 x 10 km crescent shape with the concave side of the crescent facing NW and presenting relatively steep, 400 m high faces above

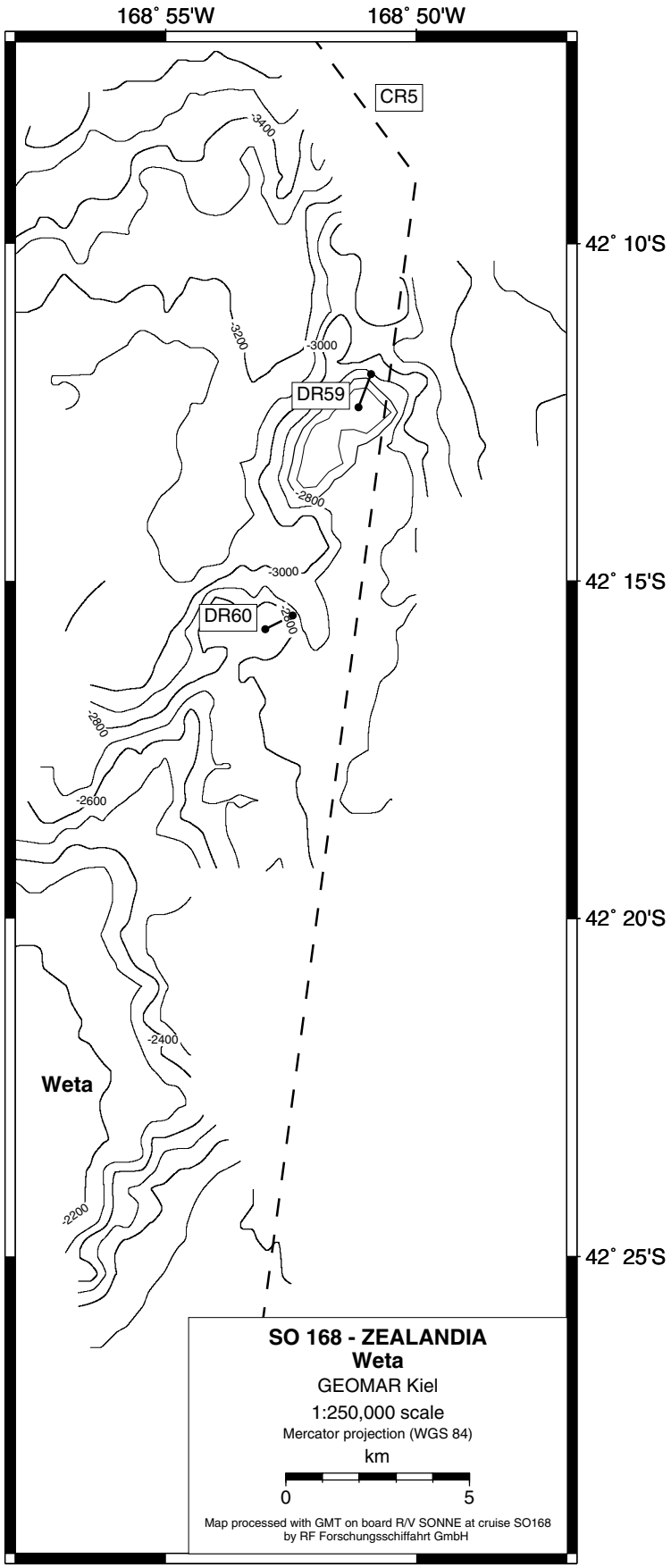

Fig. 6.28.: Bathymetric map of the eastern part of Weta Guyot and an associated volcanic rift arm including locations of dredge tracks DR 59, DR 60, and GNS seismic line CR5.

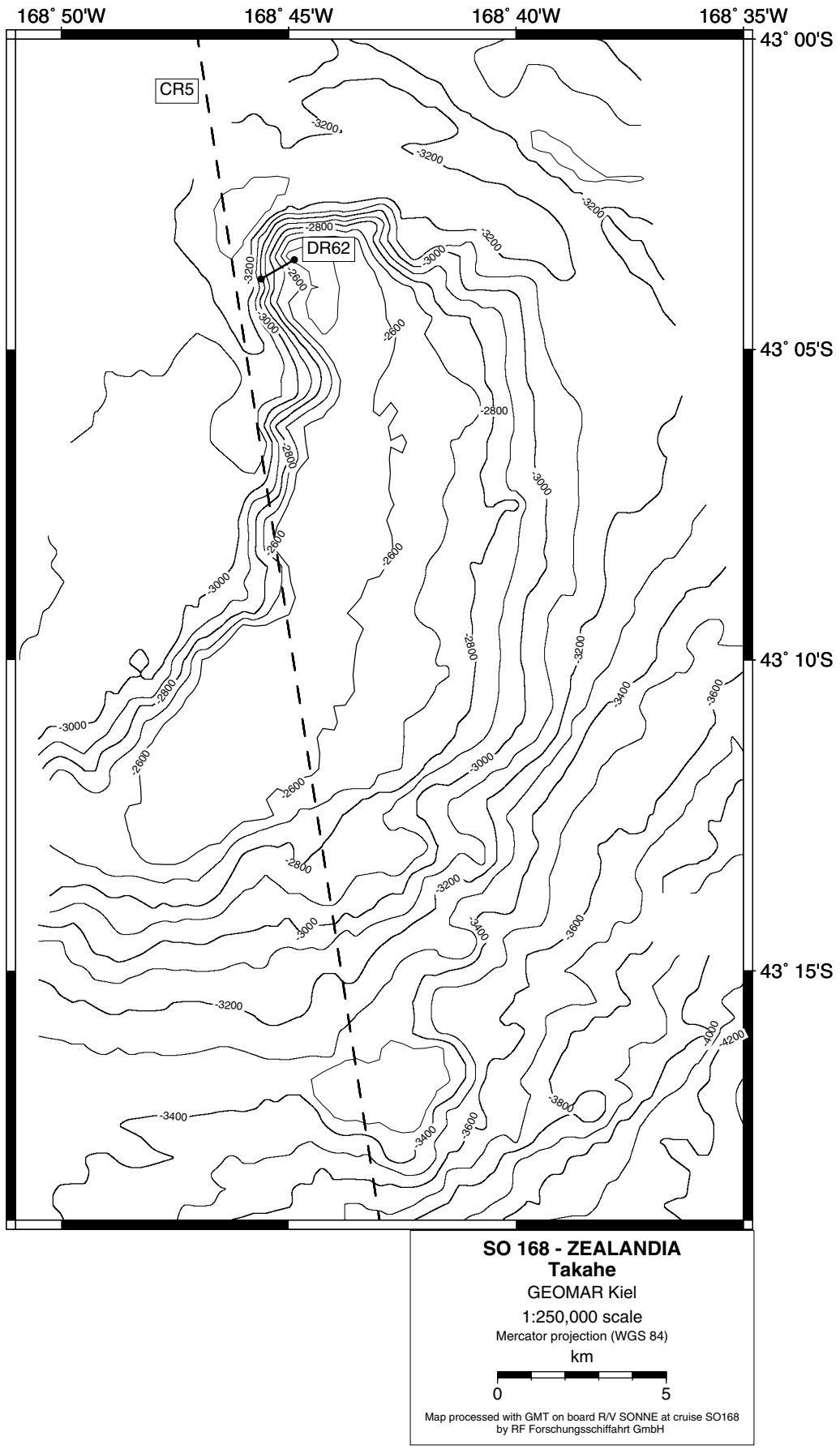

Fig. 6.29.: Bathymetric map of Takahe Fault Block including locations of dredge track DR 62 and GNS seismic line CR5.

a perched 3,100 m valley. Most of the convex side slopes gently down to the Southern Ocean abyssal plain at 4,100 m, though a landslide or fault block may have detached downslope from Takahe to 43°17'S, 168°42'W. There are no apparent volcanic cone morphologies on Takahe.

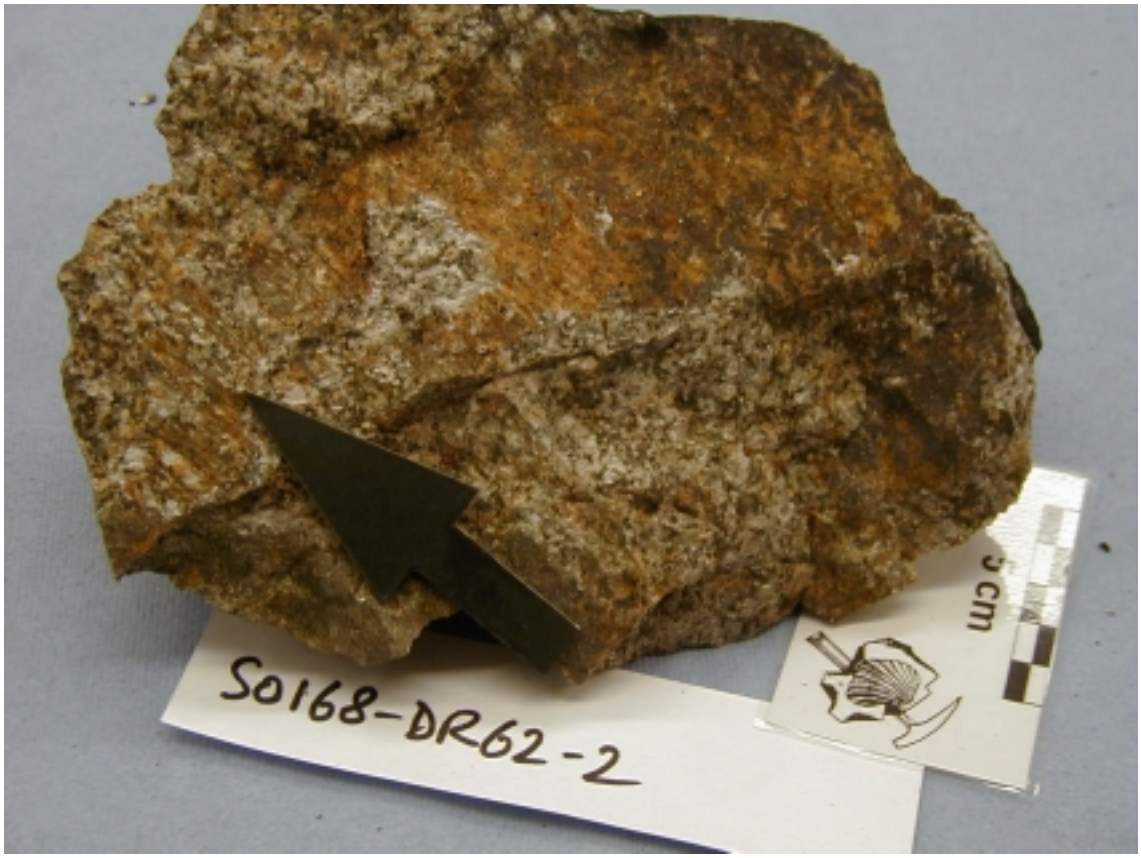

Fig. 6.30.: Cataclastic feldspar porphyritic dacite-granite from Takahe dredge site. Arrow points, and is parallel, to slickensides. Another hematitic microfault crosses the sample from lower left to middle right.

A dredge across the NW nose-like corner of the plateau gave half dozen large (up to 1.5 m) blocks of Mn-crusted fresh, variably cataclasized volcanic-hypabyssal dacitic-granitic rocks. The weathering rinds and monotony of lithology, despite large recovery, in the dredge rules out an ice-rafted origin and the rocks are interpreted to be in place. Some of these silicic igneous rocks have thin (<0.5 cm) mylonite zones and most boulders are cut by epidotized microfaults 1 - 10 cm apart. It is probable that there is a fault zone along the west and/or north sides of Takahe. The SIMRAD EM 120 gravity maps, seismic section and evidence of faulting within the recovered rocks are consistent with Takahe being a tilted fault block.

The comments that were made regarding the interpretation of the Wishbone siliceous igneous rocks can also be made for Takahe. However, the higher elevation and presence near the crest of the Chatham Rise, make the Takahe occurrence of high level granites less unexpected. At least two preliminary models are possible: Takahe dacites-granites are (1) direct equivalents of late- to

post-subduction continental silicic associations in onland New Zealand (e.g., Mt Somers, Mt Camel, Berlins Porphyry-Stitts Tuff); (2) of Cretaceous rift origin because such silicic igneous associations are unknown from the Pahau, Rakaia, Caples and Maitai terranes that might be expected to underlie the eastern Chatham Rise. Perhaps the (then waxing) Pacific-Antarctic ridge or a continuation of (waning) intra-Pacific Ocean spreading centers, stalled or impinged on the eastern continental borderland of Zealandia and caused distributed crustal thinning and generation of silicic magmas. Tests of the correlation and character of the Takahe dacites-granites will have to await age dating and petrological and geochemical investigations.

6.5.3. Southern Rift Margin

Kakapo Guyot (DR 61, 63)

Kakapo is 20 km SSW of Takahe. It has a pronounced +30 mgal gravity anomaly and is oceanward of what might be picked as the continental shelf. Kakapo was selected as a dredge target based on its appearance in GNS seismic line CR2, a steep-sided, sediment-capped seamount. A fault versus volcanic origin could not be clearly understood from the MCS line.

SIMRAD EM 120 mapping showed Kakapo to be a guyot-type seamount with a circular, relatively steep-sided base (about 15 km in diameter at its base), which rises from 4,000 m to a flat plateau at 2,500 - 2,600 m topped by a single, <100 m high small cone in the center (Fig. 6.31.). Two dredges on Kakapo produced volcanic breccias with small lava clasts prevaded by phosphate and Mn-Fe- oxides. Potentially analyzable clasts from DR 63 are plagioclase-phyric basalts. The mapping and sampling demonstrate that this seamount is volcanic in origin.

Kiel Guyot (DR 64)

Kiel is 40 km SE of Kakapo and has a larger positive gravity anomaly over it. GNS MCS line CR5 crosses Kiel, and in profile it is seen to be a broad, sediment-covered seamount. Slopes were not steep and, initially, Kiel was not prioritized for dredging. A small volcanic cone atop Kiel was also seen on MCS line CR5.

SIMRAD EM 120 mapping showed Kiel to be a guyot, ~16 km in diameter at its ~4,500 m base, rising to a domed plateau at ~3,400 - 3,600 m (Fig. 6.32.). Kiel is asymmetric, with the flat plateau centered in the north part of the seamount, separate from a satellite volcanic cone complex on the south flank. The entire seamount is interpreted to be of volcanic origin. Slopes on Kiel were not steep. One dredge, DR 64 near the top of Kiel, did not yield any rocks.

The ~1,000 m difference in the elevations of the erosional platforms of Kakapo and Kiel are consistent with greater subsidence of Kiel guyot, due to its location further from the rifted continental margin.

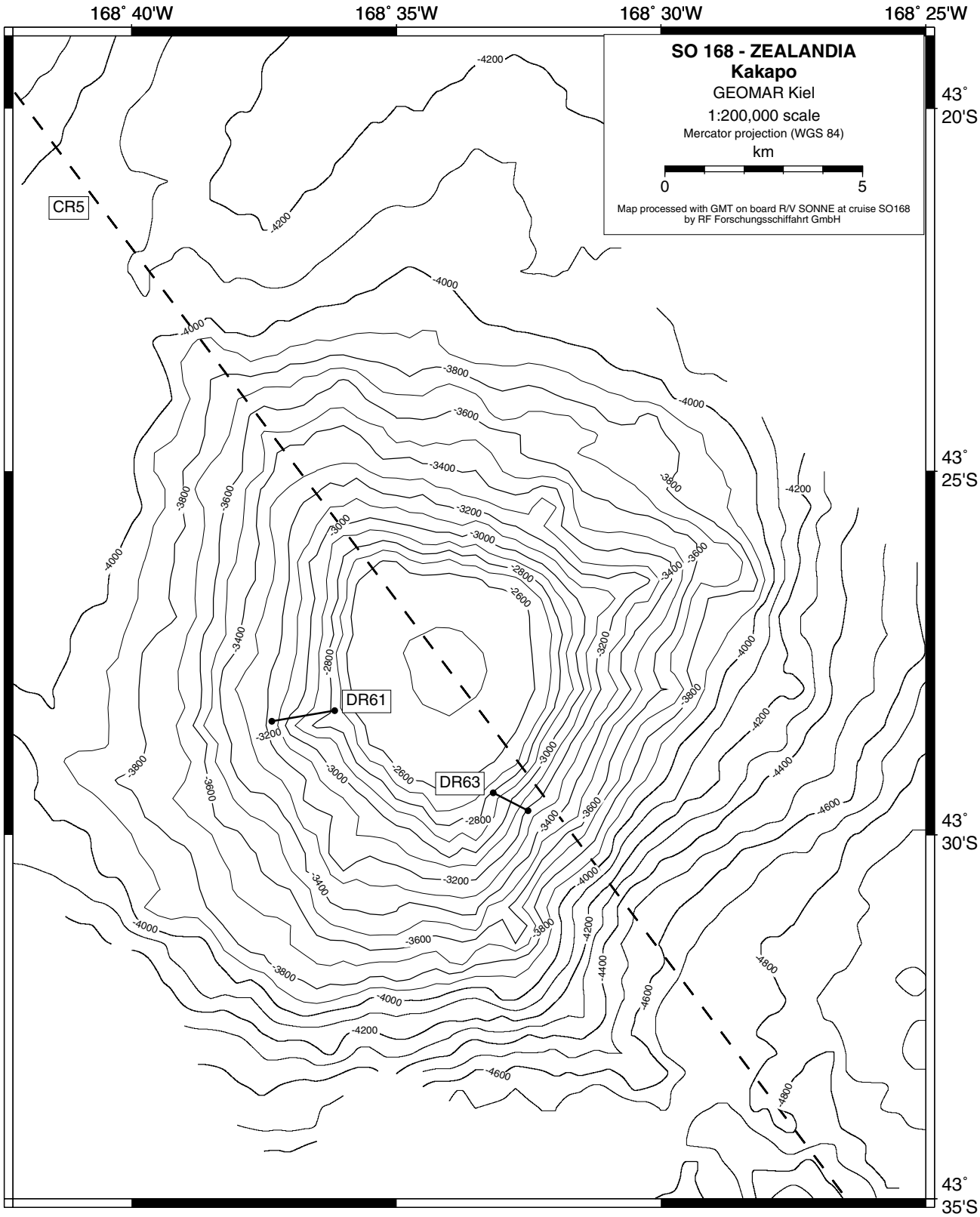

Fig. 6.31.: Bathymetric map of Kakapo Guyot including locations of dredge tracks DR 61, DR 63, and GNS seismic line CR5.

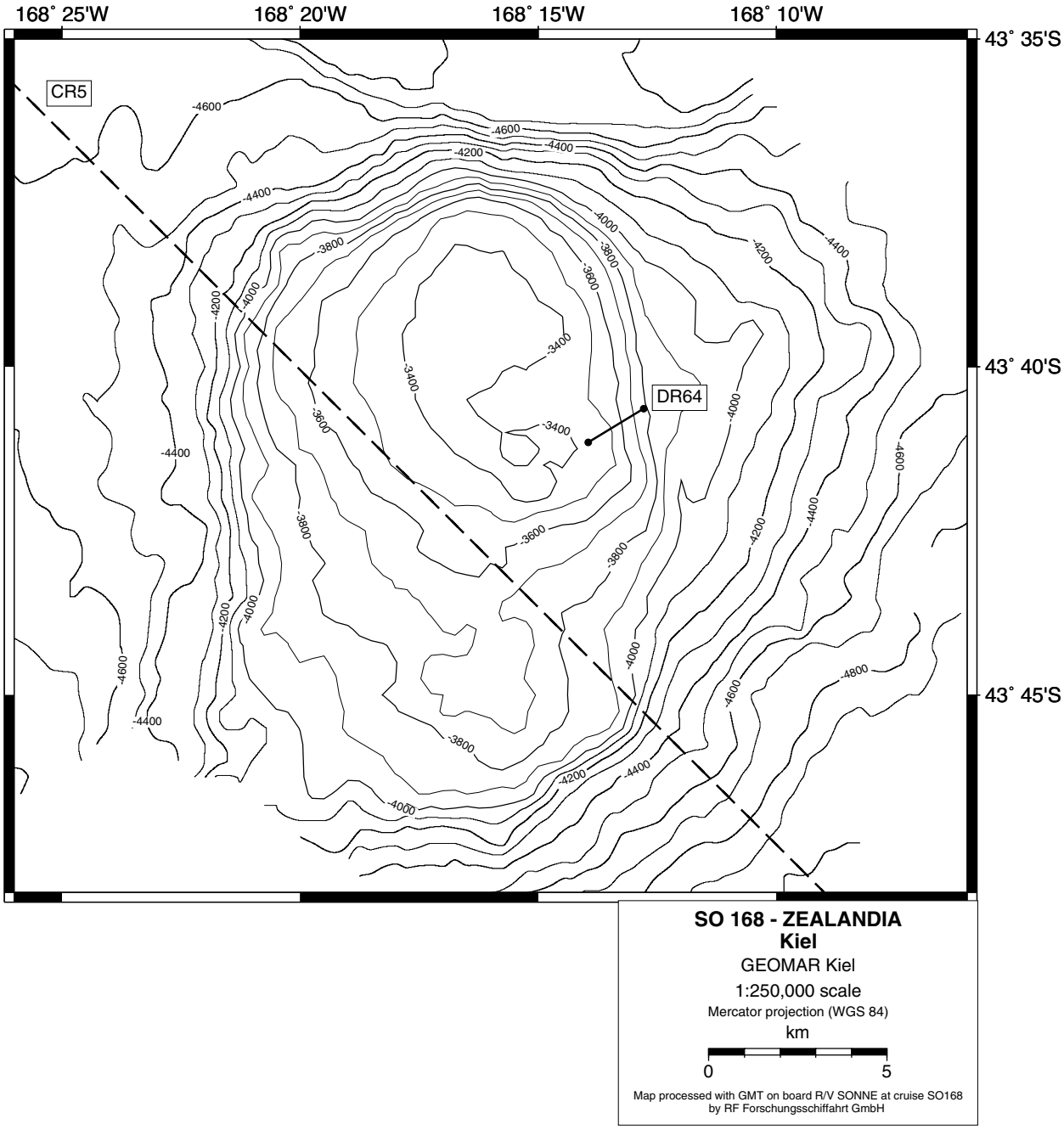

Fig. 6.32.: Bathymetric map of Kiel Guyot including locations of dredge track DR 64 and GNS seismic line CR5.

Hamburg Ridge (DR 65)

Hamburg is 140 km SW of Kiel and is one of a pair of isolated seamounts between Kiel and Berlin. The other (un-named and un-surveyed) seamount lies 20 km SE of Hamburg. The satellite gravity map shows that the SE-trending [Udintsev?] oceanic fracture zone lies between Kiel and Hamburg. Kiel and Hamburg are 50 and 90 km distant from the fracture zone, respectively.

SIMRAD EM 120 mapping shows Hamburg to be a ridge-type volcano, possibly consisting of two large, partly coalesced volcanoes lying on a NW trend of –45° (Fig. 6.33.). The base measures some 20 x 13 km and lies on the abyssal seafloor at 5,000 - 5,100 m. The shallowest peaks are at ~3,200 m. It is interesting to note the parallelism of the Udintsev fracture zone with the NW elongation of Hamburg seamount. Other seamount groups shown on the gravity map north and south of Hamburg also line up on SE trends. These observations suggest a tectonic control of the Cretaceous seafloor volcanism (compare with site DR 43).

Dredge DR 65 was made along a NW ridge on the main southern top of Kiel. It gave a single large Mn block that contained small, but analyzable, plagioclase- olivine- phyric amygdaloidal lava corestones. Phosphorite nodules were also present in the block.

Berlin Guyot (no dredge)

Berlin is a large, isolated seamount with a large positive gravity anomaly, ~100 km WSW of Kiel. No magnetic or seismic data were available for the seamount. SIMRAD EM 120 mapping showed Berlin to be a volcanic guyot (Fig. 6.34.). Measured elevations are: abyssal seafloor ~4,500 m, guyot top ~2,400 m, subcircular base 18 km. Some uneroded cones and volcanic ridges are present on the flanks of Berlin (all below 2,400 m). No slopes suitable for dredging were identified and no dredges were made.

Erik Guyot (DR 66)

Erik has the highest positive gravity anomaly of any of the seamounts south of the Chatham Rise. On the TOPEX bathymetry map it is ~60 km WNW of Berlin and appears as one of the highest and steepest seamounts south of the Chatham Rise. In contrast to most other seamounts surveyed on this trip, the magnetic map (Sutherland 1996) showed that Erik has a clear negative magnetic anomaly. This suggests it is both strongly magnetic (volcanic) and erupted in a reversed polarity interval (i.e. < 84 Ma).

SIMRAD EM 120 mapping showed Erik to be classic, symmetrical guyot with abyssal plain at ~4,500 m, flat plateau top at ~2,200 - 2,300 m and basal diameter of ~25 km (Fig. 6.35.). Volcanic ridges and cones are visible on the flanks, but none above the flat top, so it is not known if these cones represent pre- or post erosional eruptions. A single dredge, DR 66, was

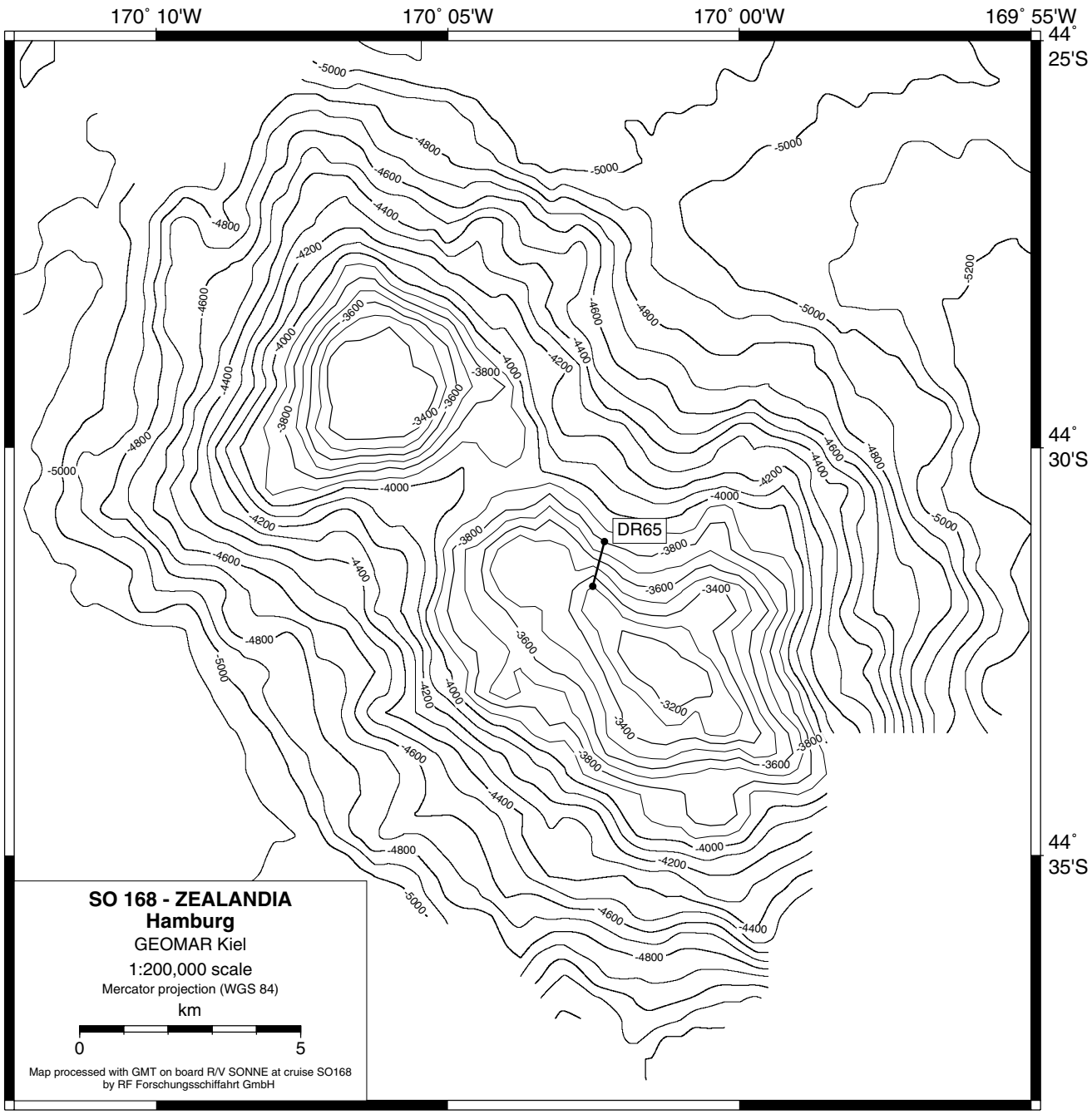

Fig. 6.33.: Bathymetric map of Hamburg Ridge including location of dredge track DR 65.

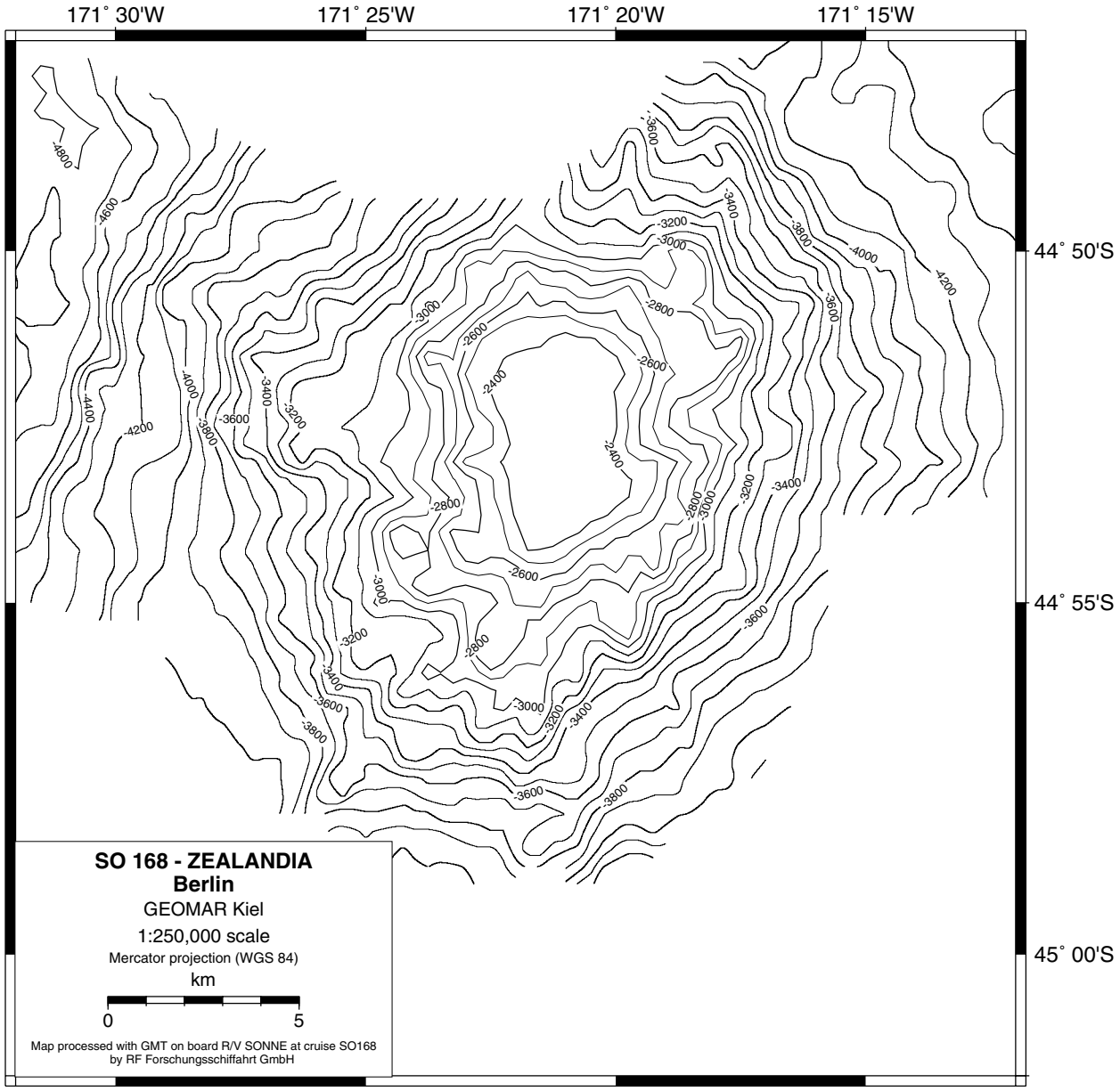

Fig. 6.34.: Bathymetric map of Berlin Guyot.

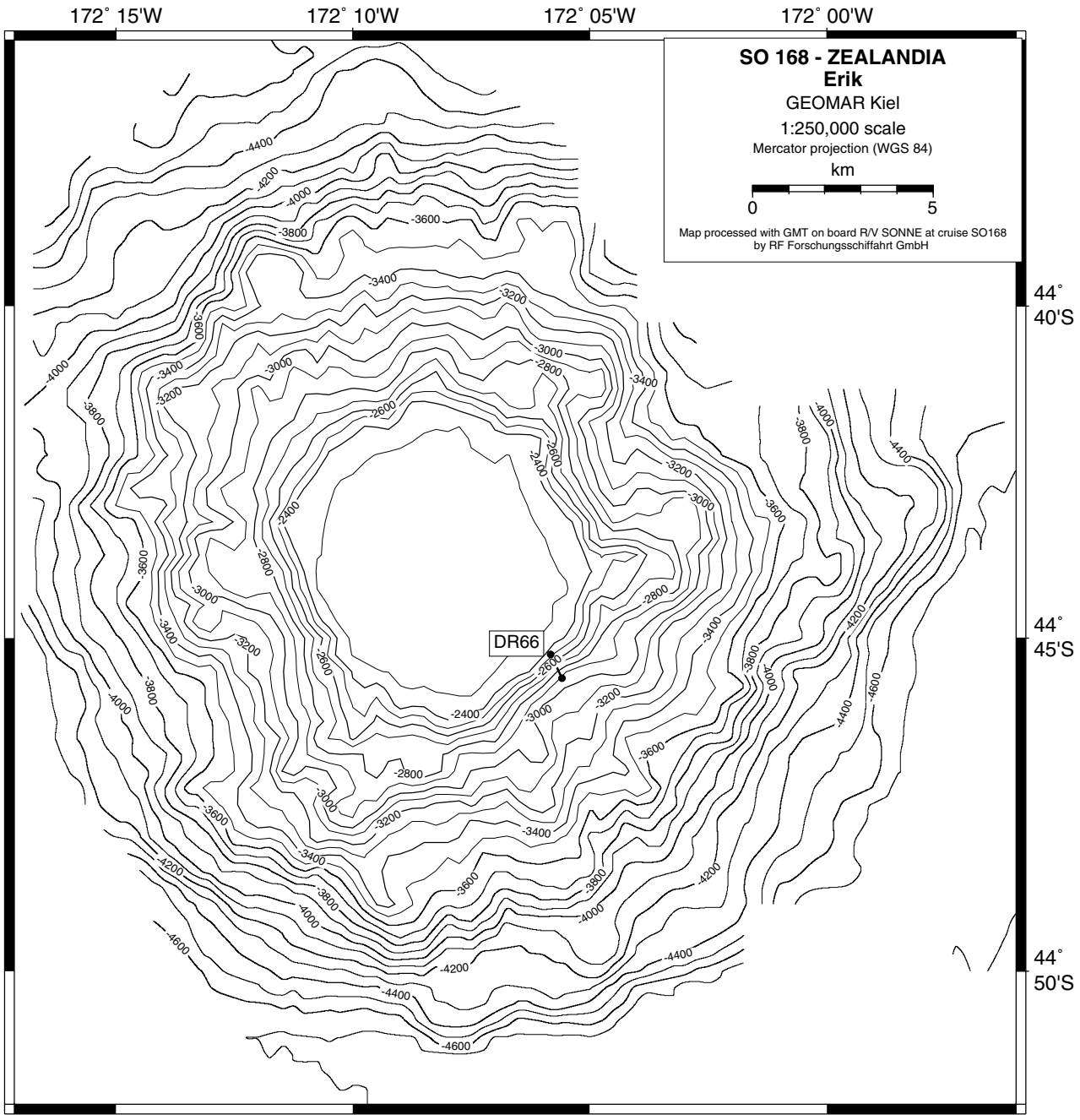

Fig. 6.35.: Bathymetric map of Erik Guyot including location of dredge track DR 66.

made on the (steepest) southeastern slope just below the plateau. It yielded a few pieces of sparsely plagioclase-phyric basalt pieces (one very fresh) and a phosphorite nodule.

Frankfurt Guyot (DR 67)

Frankfurt is an isolated guyot-type seamount with a moderate postive gravity anomaly ~90 km SW of Erik. No magnetic or seismic data were available for Frankfurt. SIMRAD EM 120 mapping shows Frankfurt to be subcircular, 20 km in basal diameter. It rises from abyssal plain depths of ~4,900 m to a small, but distinct flat top at ~2,600 m (Fig. 6.36.). The plateau is possibly too small to reveal the presence of any post-erosional volcanism, if it was ever present. Dredge DR 67 on the eastern flanks of Frankfurt produced a large quantity of two types of lava: one aphyric and highly vesicular, the other ca 20% porphyritic (feldspar and/or feldspathoid) with fewer vesicles.

Stuttgart (TVG 68, GKG 69, DR 70-71)

Stuttgart is ~45 km W of Frankfurt. TOPEX bathymetry showed that Stuttgart is lower than Frankfurt, and more irregular in shape. On the satellite gravity map, Stuttgart has a moderate gravity anomaly (lower than Frankfurt) and is separated from Greifswald and Bremen by an EW trending gravity low. No magntic data were available for Stuttgart. On GNS MCS line CR1d, Stuttgart appears as an isolated, hump-shaped symmetrical seamount surrounded by flat ocean floor to the NW and SE at 4,800 m. No obvious faults were seen to bound Stuttgart on the MCS line and its nature, volcanic or fault-bounded or both, could not be established prior to the SO 168 survey.

SIMRAD EM 120 mapping revealed no volcanic cone features on Stuttgart, but a broad EW trending 12 x >25km long asymmetric ridge with a crestline above the steepest, southern, slope (Fig. 6.37.). The top of the seamount is at ~3,700 m, much deeper than Frankfurt guyot. The interpretation of the SIMRAD EM 120 mapping was that Stuttgart is a gently N-tilted horst of continental material, bounded by a major fault on the steep, S side, and possibly also on the N and E sides. Dredge DR 71 from the steepest, SE corner of Stuttgart, yielded no volcanics, but only pieces of greenish-grey segregated schist and phyllitic schist, confirming the non volcanic, continental nature of this block. Therefore it is clear that sea floor mapping can successfully identify volcanic versus fault-block origins of seamounts. Speculatively, the schist foliation may be repsonsible for some of Stuttgart‘s shape (e.g. subplanar surfaces). In summary, SIMRAD EM 120 mapping and dredge samples are consistent with Stuttgart representing a stranded tilted fault block (horst) of continental material. In this respect it is similar to Bollons Seamount, on the opposite side of the Bounty Trough.

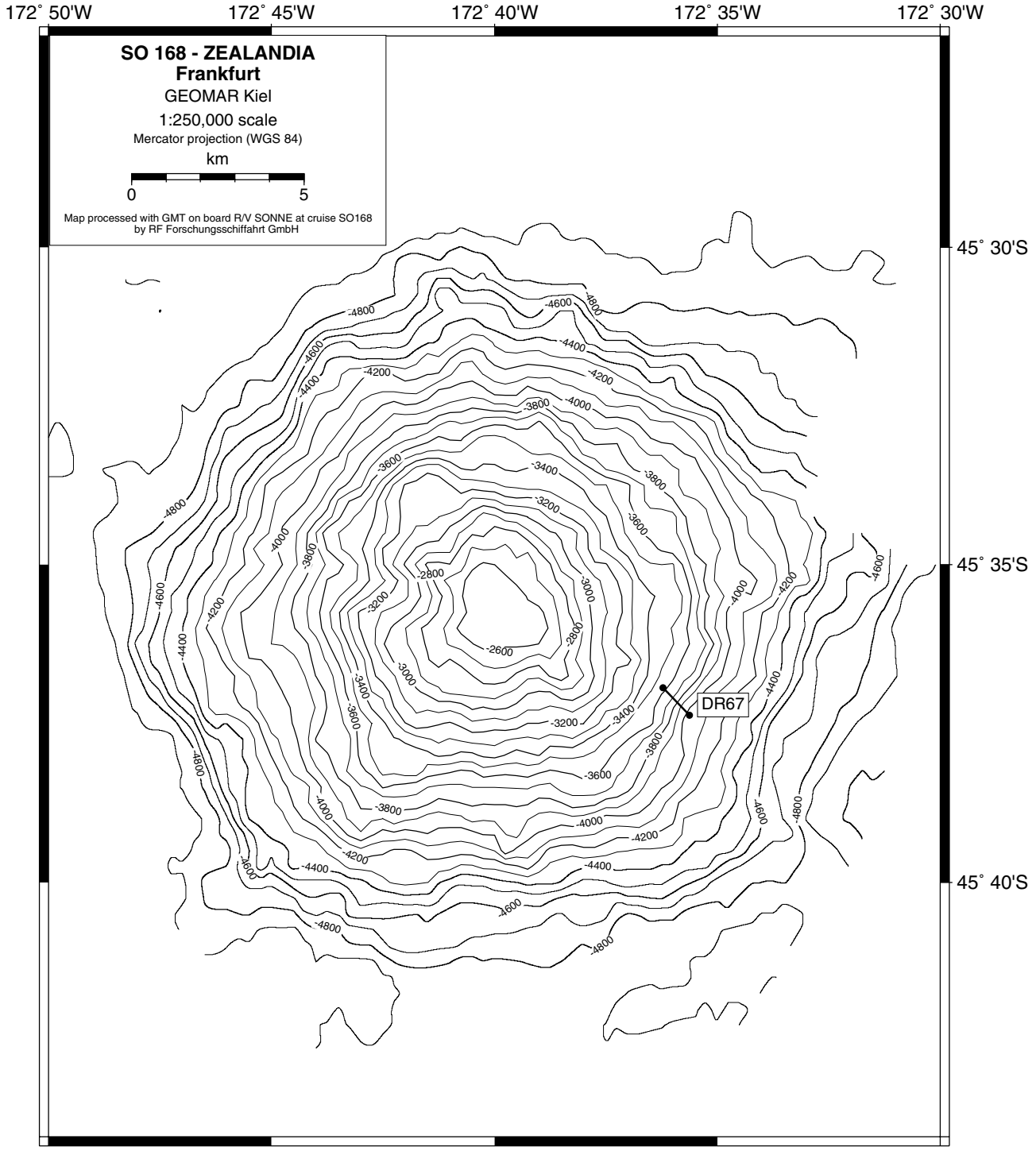

Fig. 6.36.: Bathymetric map of Frankfurt Guyot including location of dredge track DR 67.

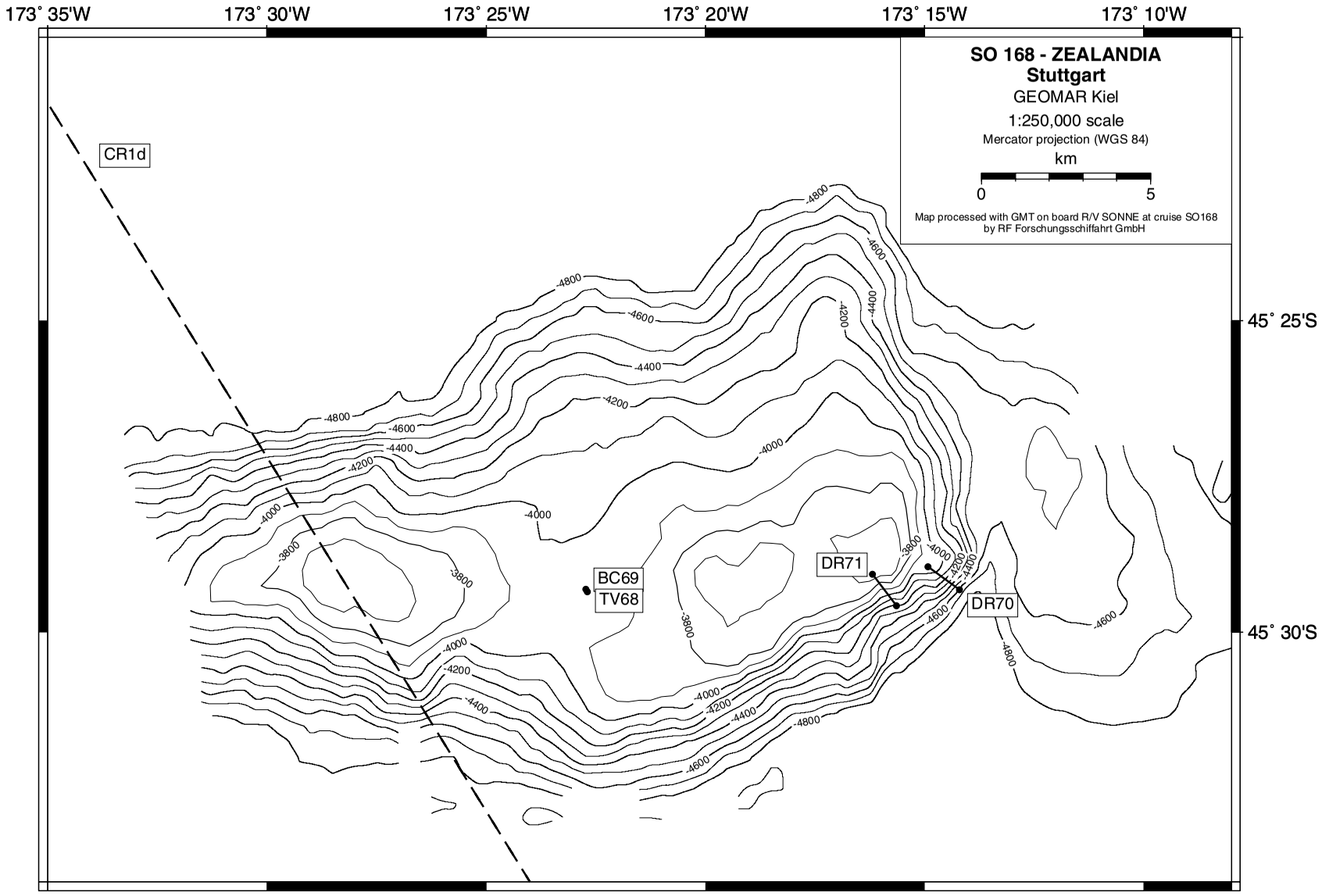

Fig. 6.37.: Bathymetric map of Stuttgart Seamount including locations of dredge tracks DR 70 and DR 71, TV-grab 68, giant box corer 69 and CNS MCS line CR1d.

The nearest known exposures of schist are on the Chatham Islands, ~270 km to the NE. The Stuttgart schist would seem to indicate that the Chatham Schist (Rakaia terrane) extends to the south edge of the Chatham Rise. Furthermore, at least some of the broad areas of neutral to slightly positive gravity anomalies east of the Bounty Trough (shaded green on most GNS gravity maps) are probably underlain by thinned continental crust. These contrast with the more circular shaped features of high gravity anomaly (Frankfurt, Berlin, Hamburg) which are unfaulted constructional volcanos.

Greifswald & Bremen (no dredges)

Greifswald and Bremen are NNW of Stuttgart and are separated from Stuttgart by a 30 km wide basin with a depth of >5,000 m. TOPEX bathymetry shows Bremen to be part of a NE-SW trending ridge above where the seafloor drops abruptly from 3,500 to 4,500 m. Greifswald is not discernable on the TOPEX or satellite gravity maps. No magnetic data were available for these seamounts. On GNS seismic line CR1d, petrologic interpretation showed Griefswald and Bremen to be neighbouring asymmetric fault blocks, apparently bounded on their SW sides by two major SW-dipping faults; another minor fault is present within Greifswald.

SIMRAD EM 120 mapping confirmed the lack of volcanic cones on Griefswald and Bremen and confirmed the interpretations made using seismic interpretation (Fig. 6.38.). Additionally, the true, east-west, strike of the faults was revealed. In view of the similarity of structure of Stuttgart, Greifswald and Bremen, their similar gravity anomalies, and the recovery of schist from Stuttgart, it is likely that Greifswald and Bremen also represent faulted continental blocks and therefore no dredges were made on these structures.

München (DR 72)

München forms a broad topographic swell on the southern edge of the Chatham Rise. It has a moderate positive magnetic anomaly over it, and its gravity anomaly is higher than Frankfurt (comparable to Berlin). No seismic data were available.

SIMRAD EM 120 mapping showed München to be a volcanic seamount with a prominent flat-topped plateau at 1,800 - 1,900 m depth (Fig. 6.39.). At least one younger post-plateau cone rises 200 m above the plateau. München stands high above the 2,700 - 3,000 m sea floor to the south and east, but rises much less above the 2,400 m high Chatham Rise to the north. Dredge DR 72 was made in the upper part of a prominent valley on the east side of München. Most of the dredge contained yellow and orange, moderately to well-sorted volcanic lapilli breccias. At least one plagiolclase-phyric lava fragment (~5 cm in diameter) in the breccias is a volcanic bomb. Three ice-rafted dropstones, red metaquartzite, megacrystic granite-gneiss, and paragneiss were identified. Nodular phosphorites were also present.

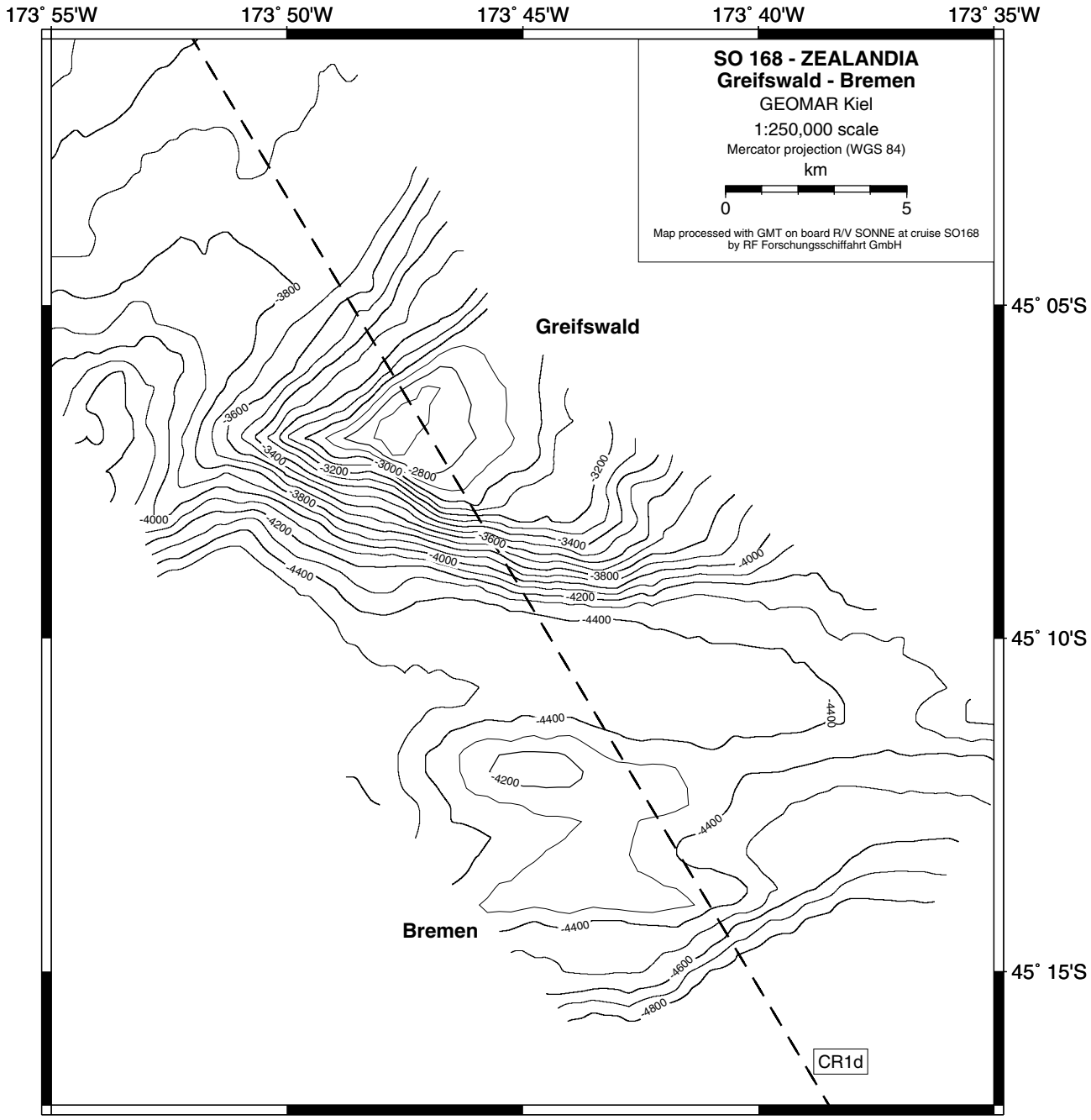

Fig. 6.38.: SIMRAD track across Greifswald and Bremen Seamounts. The location of CNS MCS line CR1d is also shown.

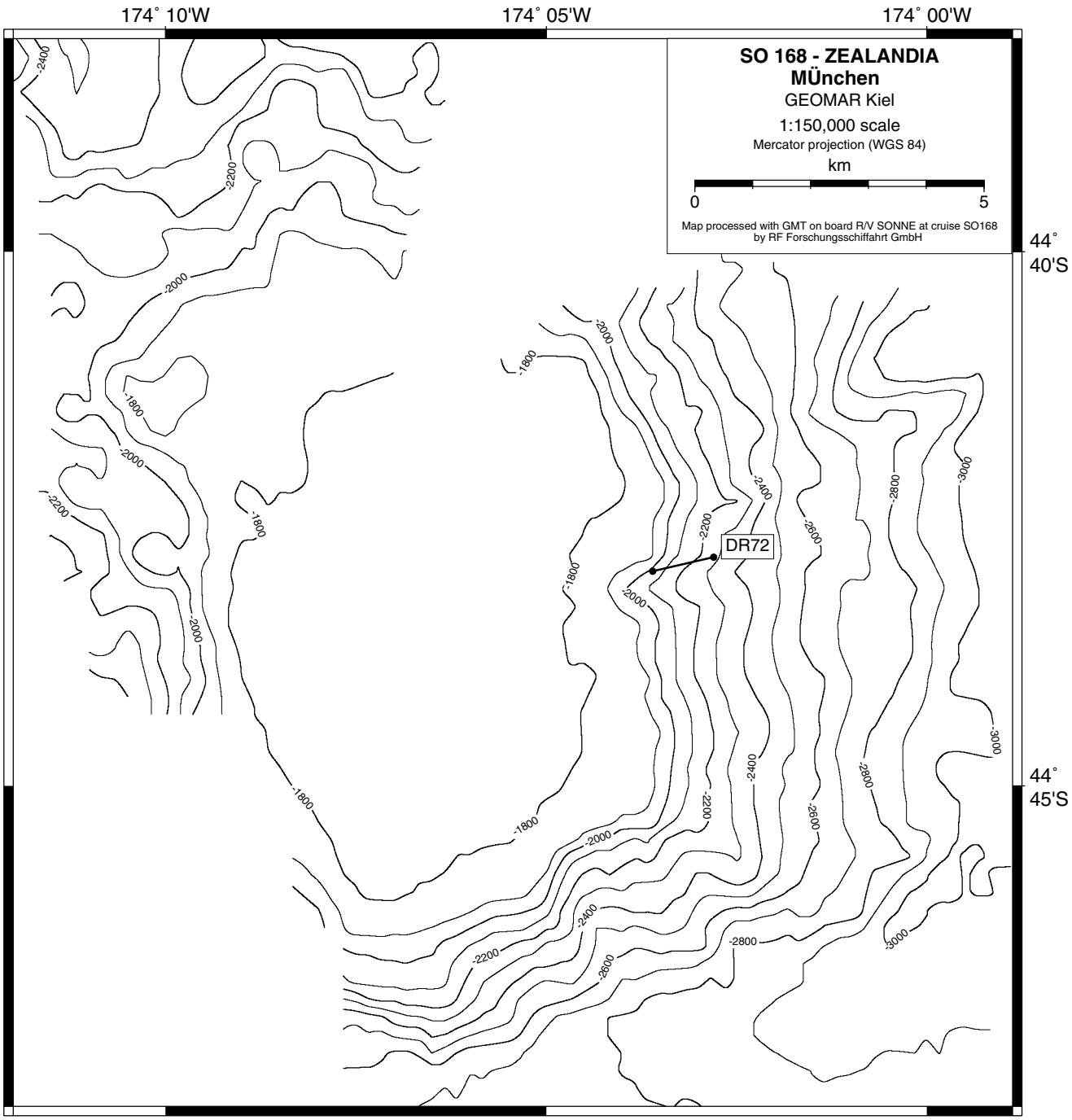

Fig. 6.39.: Bathymetric map of München Guyot including location of dredge track DR 72.

Summary

The eastern Chatham Rise region encompasses the Chatham Rise east of longitude ~174° W and seamounts to the north (including Wishbone Ridge) and south. To the north of the easternmost Chatham Rise, a 53 km long, very steep-sided, flat-topped ridge in the SW arm of the Wishbone Ridge has a similar NNE strike as the gravity anomaly. Sampling of three localities along its SW flank produced plagioclase-rich dacites and sandstones. The shape of the ridge and cataclastic textures (including slickensides) of some of the samples is consistent with the ridge being a sliver within a fault system whose top was eroded at sea level (as suggested by the presence of the coarse sandstones). Chicken guyot and the Pukeko volcanic ridge east and southeast of the Wishbone Ridge yielded aphyric basalt and plagioclase-rich dacites.

On the easternmost end of the Chatham Rise, vesicular aphyric basalt was obtained from the NNE rift arm of the Weta guyot-type seamount volcano. The erosional platform on Weta is located only 600 m above the sea floor to the south, suggesting that this part of the Chatham Rise was also shallower than 1,000 m water depth before rifting of Zealandia from Antarctica using an estimate of 300 - 400 m for the sediment thickness in this area. Takahe Seamount, to the south of the Weta Seamount, forms a broad flat ridge, intepreted to be a tilted, fault-bounded block. The dacitic to granitic rocks were recovered from Takahe, some samples having cataclastic textures consistent with derivation from a fault margin. There are at least two models to explain the presence of the Takahe dacitic to granitic rocks: (1) they are direct equivalents of late- to post-subduction continental silicic associations in onland New Zealand (e.g., Mt Somers, Mt Camel, Berlins Porphyry-Stitts Tuff); (2) they are rift-related volcanics associated with the break-up of Zealandia from Antarctica. Age dating and petrological and geochemical investigations are necessary to distinguish between these possibilities.

The similarity in rock types (dacitic to granitic) from the Wishbone Ridge and the Takahe fault block, and plagioclase-rich mafic-intermediate lavas from Chicken and Pukeko Seamounts suggest that the region between the eastern northern Chatham Rise and Wishbone Ridge may have once been part of continental Zealandia. Extensive thinning may have occurred during the rifting of Zealandia from Antarctica, as is also believed to be the case for the seamounts south of the eastern Chatham Rise. Alternatively these evolved igneous compositions may have been generated by interaction of Phoenix-Pacific-Moa plate spreading centers with the Gondwana margin.

SIMRAD EM 120 mapping of nine seamounts south of the eastern Chatham Rise suggested that six were guyots, one a ridge-type volcanic structure and two tilted, fault-bounded horsts. Sampling of four guyots and the ridge structure confirmed that they were indeed volcanic in origin with samples being primarily plagioclase basalt. Sampling of a scarp of one of the horsts

produced low grade schists (similar to the Chatham and Otago schists) consistent with it being a faulted continental block, even though it is clearly separated from the faulted and extended southern margin of the Chatham Rise by a 30 km wide basin with a depth of >5,000 m. The flat erosional surfaces on the guyots and the tilted fault blocks are presently located at water depths of 2,000 - 3,400 m, indicating a variable amount of net subsidence of these volcanic structures. The large net subsidence and evidence for faulting are likely to be related to the Late Cretaceous rifting of Zealandia from Marie Byrd Land, Antarctica.

6.6. CENTRAL AND WESTERN CHATHAM RISE

6.6.1. Chatham Islands Region

A prolonged history of volcanism is preserved in the onland geological record of the Chatham Islands (Morris 1985a, b, Gamble et al. 1986, Wood et al. 1989 and references therein). Two main data sources were used to target SO 168 dredge sites: (1) records of previous dredges of samples, mainly by fishing vessels in the 1990s, with location and sample data provided from GNS's PETLAB database or by Wood et al. (1989); (2) a 1: 1,000,000 scale seafloor geological map of the Chatham Rise (Map 11 of Wood et al. 1989), that showed magnetic anomalies and outcrop areas of volcanic rocks of different ages, inferred from reflection sesimic lines. In some cases the regional scale TOPEX bathymetry maps were able to confirm the bank- or rise-like shapes of some of the larger dredge targets. The whole Chatham Islands area is a positive gravity high, perhaps reflecting the large volume of near surface basaltic rocks. Detailed interpretation of individual anomalies was not done.

A total of 15 sites were visited near the Chatham Islands, (some sites were dredged more than once). The success rate for different targeting methods was as follows: location by previous fishing dredge 4 successful out of 6 sites (no dredgable features were seen at the reported coordinates of Hardcastle and Lucky); location by seafloor geological map 4 successful out of 8 sites visited (and nothing but flat seafloor in the other four); hill on TOPEX bathymetry map one successful of one. Four of the five largest areas of seafloor volcanic outcrop near the Chathams (Howson, Charlton, Perry and Manley) were sampled. SIMRAD EM 120 maps are presented for five sites that are representative of the general range of morphological volcanic styles: Western Uprising-Chapmans Hill, Howson, FBI, Monkhouse and Manley (Figs. 6.40. - 6.44.).

Western Uprising & Chapmans Hill (DR 73-74)

These features are 55 km NNW of München Seamount and about 130 km E of Chatham Island. They have a small gravity anomaly, isolated from the main Chathams gravity high. GNS samples P63479 and 63481 were previously obtained from Western Uprising.

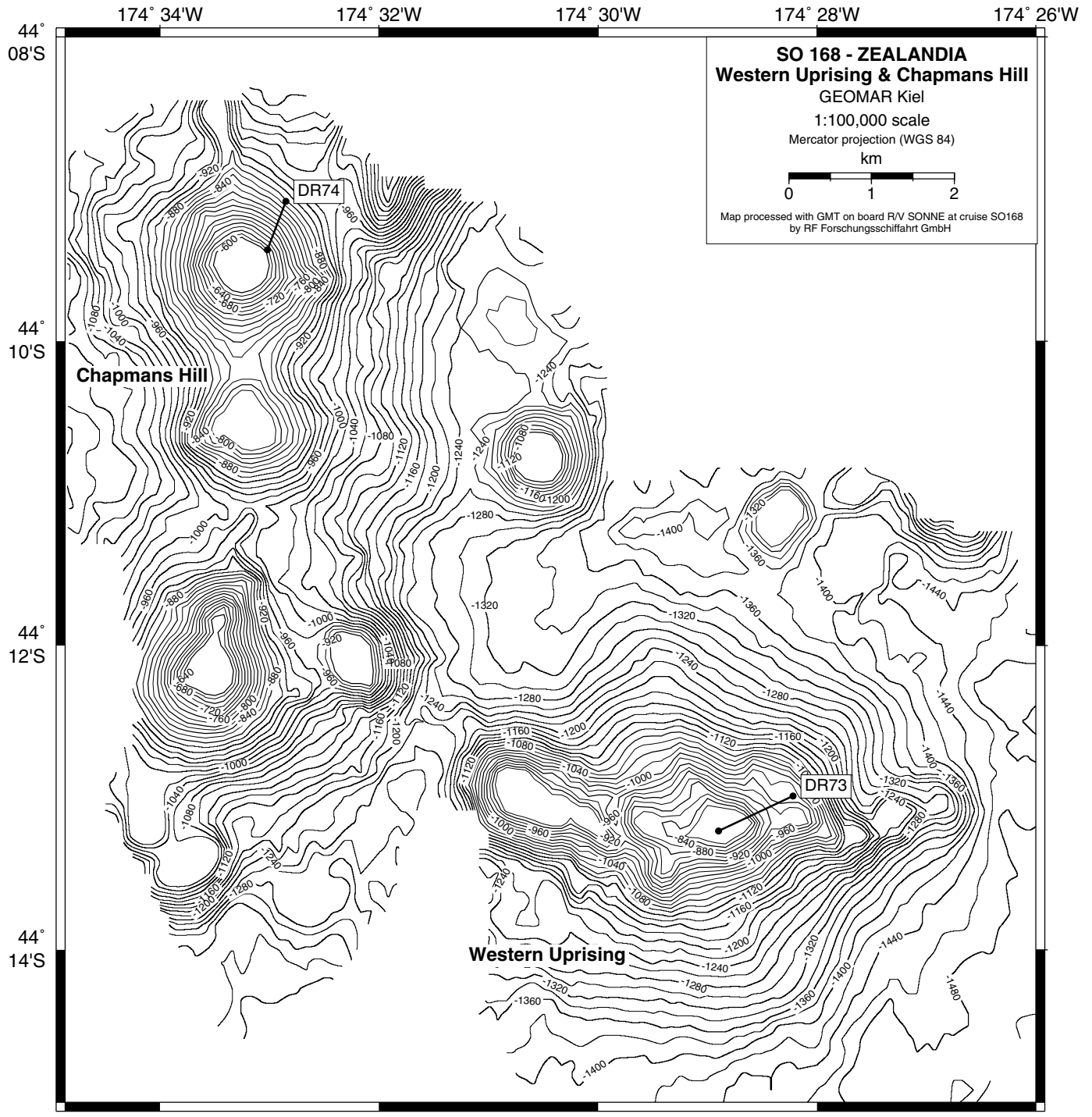

Fig. 6.40.: Bathymetric map of Western Uprising and Chapmans Hill including locations of dredge tracks DR 73 and DR 74.

SIMRAD EM 120 mappingshowed Western Uprising to be an east-west trending ridge that curves northwest then north and joins the main twin-peaks of Chapmans Hill that trend NS (Fig. 6.40.). The basal diameter of volcanic cone-like shapes is ~3 km with the hills about 600 m high. The base and top of Western Uprising are about 200 m lower than the same features on Chapmans Hill, an expression of the broad southward dip of the Chatham Rise slope.

Lavas recovered in DR 73 and DR 74 consisted mainly of hard and slightly altered grey-brown olivine-phyric calcite amygdaloidal basalts. A plagioclase- olivine- and clinopyroxene-phyric lava in DR 73 may be a dropstone. At Western Uprising, the dredge was dominated by phosphorite; altered reddish volcanic breccias, a piece of schist and a phosphatized bone were also recovered. The abundance of phosphorite may suggest a Paleogene age for the Western Uprising volcanics.

Unlucky (DR 75)

SIMRAD EM 120 mapping revealed flat sea floor at 44°23.2'S, 175°06.3'W, the coordinates for 'Lucky Hill' from which fishing dredge samples P63527 and 63528 supposedly came. However, in transit from Chapmans Hill to Lucky, a small 400 m high, 1.5 km diameter cone was seen on the SIMRAD EM 120 (base of cone at 800 m water depth). Dredge DR 75 on the SW slopes of the cone, named 'Unlucky' produced nothing.

Howson (DR 76-79)

Wood et al. (1989) show a 20 x 15 km area of Cretaceous volcanics exposed on the seafloor, ~70 km E of Chatham Island. They consider it to be equivalent to the Southern Volcanics of the Chatham Islands, and is surrounded by Early Cenozoic sedimentary rocks. It has a strong positive magnetic anomaly.

SIMRAD EM 120 mapping showed a dredgable shallow circular bank within this area (Fig. 6.41.). A pronounced break in slope at ~200 m water depth defines Howson's ~3.5 km diameter outer bathymetric limit. Within this feature is an irregularly contoured main top, and two main outlying hills about 200 m in diameter that also reach to above 100 m water depth. Although the inferred Cretaceous age suggests otherwise (Wood et al. 1989), the SIMRAD EM 120 mapping suggests that Howson represents an eroded volcano with satellite vents.

Four dredges were made, and were the shallowest of cruise SO 168 with a total depth range of 98 - 130 m. Each dredge was dominated by mainly living, Recent and sub-Recent biological material. The small quantity of rock recovered consisted mainly of brown-orange altered volcanic breccias though reasonably fresh aphyric and olivine-phyric, calcite-amygdaloidal lavas were obtained from DR 79, on the SW outlying hill.

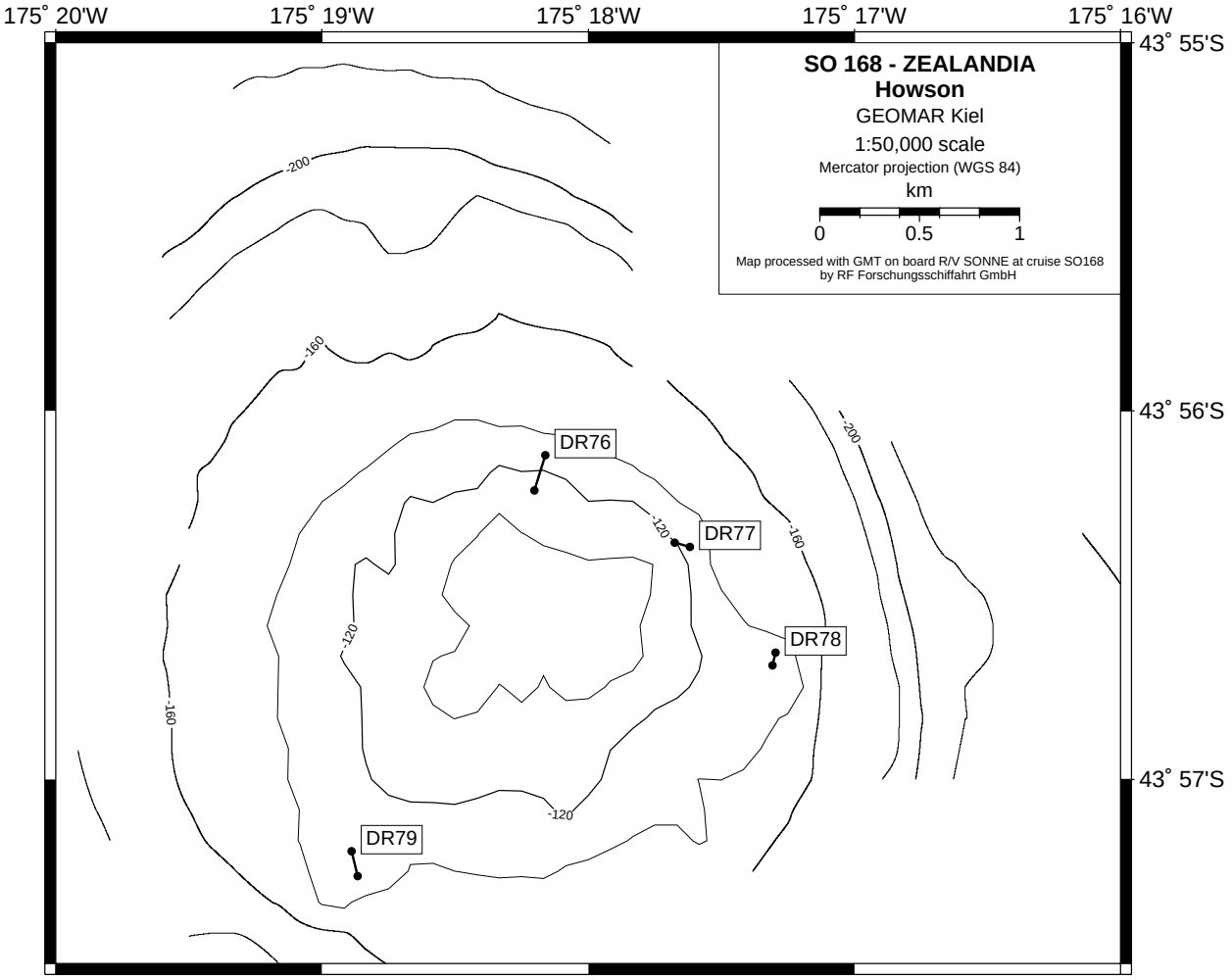

Fig. 6.41.: Bathymetric map of Howson volcano including locations of dredge tracks DR 76 - 79.

Charlton (DR 80-81)

The Charlton area was shown by Wood et al. (1989) as an area of Late Cretaceous to Paleogene volcanics, 30 km S of Howson and 50 km E of Pitt Island, surrounded by early Cenozoic sedimentary rocks. A prominent bipolar magnetic anomaly occurs very close to Charlton but it is not possible to easily resolve the polarity.

Two dredge sites were chosen, some 3.5 km apart. The narrow SIMRAD EM 120 beam width of ~1 km at these shallow water depths, and lack of time, prevented a proper mapping survey. Thus a satisfactory identification of Charlton A, the northern feature, was precluded other than that it is a steep slope along strike from a possible volcanic swell to the SW. Charlton B appears to be a more convincing volcanic cone about 2 km broad by 150 m high. Together the steep slope, possible volcanic cone and distinct volcanic peak may all constitute a broad area of volcanic outcrop several kilometers across, like Howson.

Like Howson, the Charlton A dredge produced mainly biological material. Rocks consisted of fairly fresh ol and ol- cpx-phyric, basalts, some with megacrysts and altered ultramafic xenoliths.

Charlton B was mainly one large tough boulder of brown calcite-cemented basaltic breccia with a few altered basalts, sandstone and limestone.

Hicks (DR 82)

Hicks is shown by Wood et al. (1989) as a volcanic knoll, 25 km S of Charlton in an area of scattered volcanics of probable Late Cretaceous to Paleogene age. The south edge of the volcanic area (e.g. at Hicks) is bounded by a normal fault and there is a suggestion that the location of the volcanics is fault controlled. Hicks lies within an area of a broad slightly negative magnetic anomaly.

SIMRAD EM 120 mapping showed Hicks to be a distinct submarine hill, probably a slightly-modified volcanic shape. It is located near a slope break, from 500 m water depth to the north of Hicks, to 900 m depth to the south. This slope may correspond to the position of the aforementioned normal fault. Hicks is subcircular, 3 km in diameter, with a NW ridge and has a summit height of ~200 m below sea level. Dredge DR 82 was made on the steep, SW side, and contained olive-brown altered amygdaloidal olivine basalts, probably too altered for analysis.

FBI (DR 83)

FBI is the abbreviation of a colourfully-named 'F... king Big Indian' fishing mark, 70 km SE of Pitt Island, from which sample P63482 was previously obtained. FBI has a positive gravity anomaly, slightly isolated from the main Chatham gravity high, perhaps due to sediment ponding in normal-fault controlled basins between it and Hicks. FBI has a clear negative magnetic anomaly.

SIMRAD EM 120 mapping showed that FBI is a twin-coned seamount about 2.5 km in basal diameter (Fig. 6.42.). It rises from a shelf of 1,200 m to a peak height of ~775 m. A third, isolated 1 km diameter cone lies about 3 km NNW of FBI. About 4 km SSE of FBI there is a pronounced shelf break and water depths increases abruptly to 2,000 m. Speculatively, this is also due to another normal fault, as appears to be the case near Hicks (FBI is outside Wood et al.'s 1989 map area). Dredge DR 83 was made on the south slope of the southern FBI cone and produced slightly altered amygdaloidal olivine basalts.

Gore (DR 84)

Gore is a previously un-named fishing mark ~35 km WNW of FBI and about the same distance SE of Pitt Island. Fishing dredge samples P51339, 51354-357 and 51488-490 were previously obtained from here. It is an isolated 200 m high cone-shaped hill with a basal diameter of ~1 km at 1,100 m water depth. DR 84 on the SE slope, produced mainly phosphorite, with some dropstones. The few lavas were dark brown basalts with altered olivine phenocrysts and calcite amygdules.

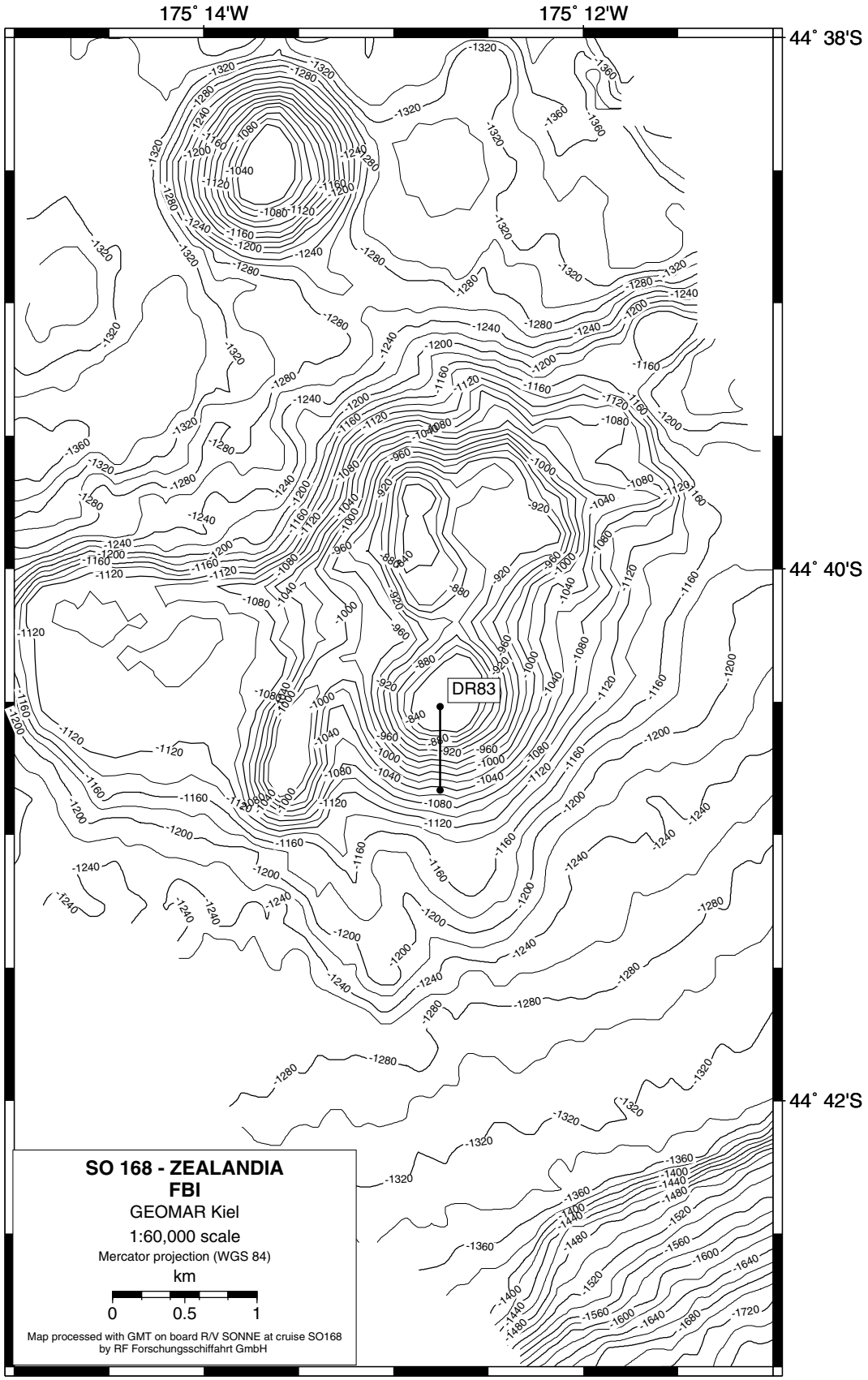

Fig. 6.42: Bathymetric map of FBI Seamounts including location of dredge track DR 83.

Monkhouse (DR 85)

Wood et al. (1989) show a broad field of Late Cretaceous-Paleogene volcanic knolls SW of Pitt Island. The area has a large, positive gravity anomaly with a steep gravity gradient where the Chatham Rise descends to the Bounty Trough. A weak positive mangetic anomlay is present over the area of scattered knolls.

About 2.5 nm east of the given position of one of these knolls, SIMRAD EM 120 mapping revealed an area of irregular hill and ridge topography (Fig. 6.43.). Monkhouse is about 30 km SSW of Pitt Island. On the SIMRAD EM 120 map, the Chatham slope is evident, with water depth increasing southward from 600 to 900 m over 4 km. The highest hill in the Monkhouse area is at 340 m water depth. The overall lack of hill symmetry when compared with FBI suggests that the volcanoes may have been somewhat eroded and/or faulted. A dredge on the steep eastern side of the southern hill gave grey but amygdaloidal olivine basalts, possibly also with fresh plagioclase and/or olivine.

Jones (DR 86)

Jones is another knoll in the volcanic field SW of Pitt, 18 km W of Monkhouse and 30 km SW of Pitt Island. It is the site of a dredged lava (Wood et al. 1989). Jones was only partly surveyed. It is a broad, 3 km diameter, 200 m high flat-topped seamount. Surrounding seafloor is at approximately 600 m, falling to the south. The overall symmetry (as far as it is revealed) and a ridge on the SW side suggest that original volcanic form is still well preserved.

Dredge DR 86 yielded a large quantity of broken pieces of living coral, suggesting that the dredge had ploughed through a mound. Five small pieces of altered olivine-phyric basalt were also recovered.

Perry (DR 87)

The only area of submarine Neogene volcanics shown by Wood et al. (1989) is an area, ~13 km across about 45 km SW of Pitt Island. It has a positive magnetic anomaly, one of the strongest in the Chatham Islands area. Perry was completely surveyed with the SIMRAD EM 120 system; it consists of a small, oval shaped seamount 3 x 2.5 km in basal dimensions at 625 m, and elongated NNE. The top is a flat plateau of about half the length and width of the base, and at 450 m water depth. Three small conical hills to the north and south may be satellite cones. Perry thus appears to preserve good, essentially unmodified volcanic morphologies. Within 2 km of Perry, partial SIMRAD EM 120 surveys of other ridges may reveal other volcanic centers that collectively define the larger area of Neogene volcanics shown by Wood et al. (1989).

Dredge DR 87 at Perry produced one third biological samples, and two thirds good fresh black ol-cpx-plag porphyritic basalts. Three dropstones were also present.

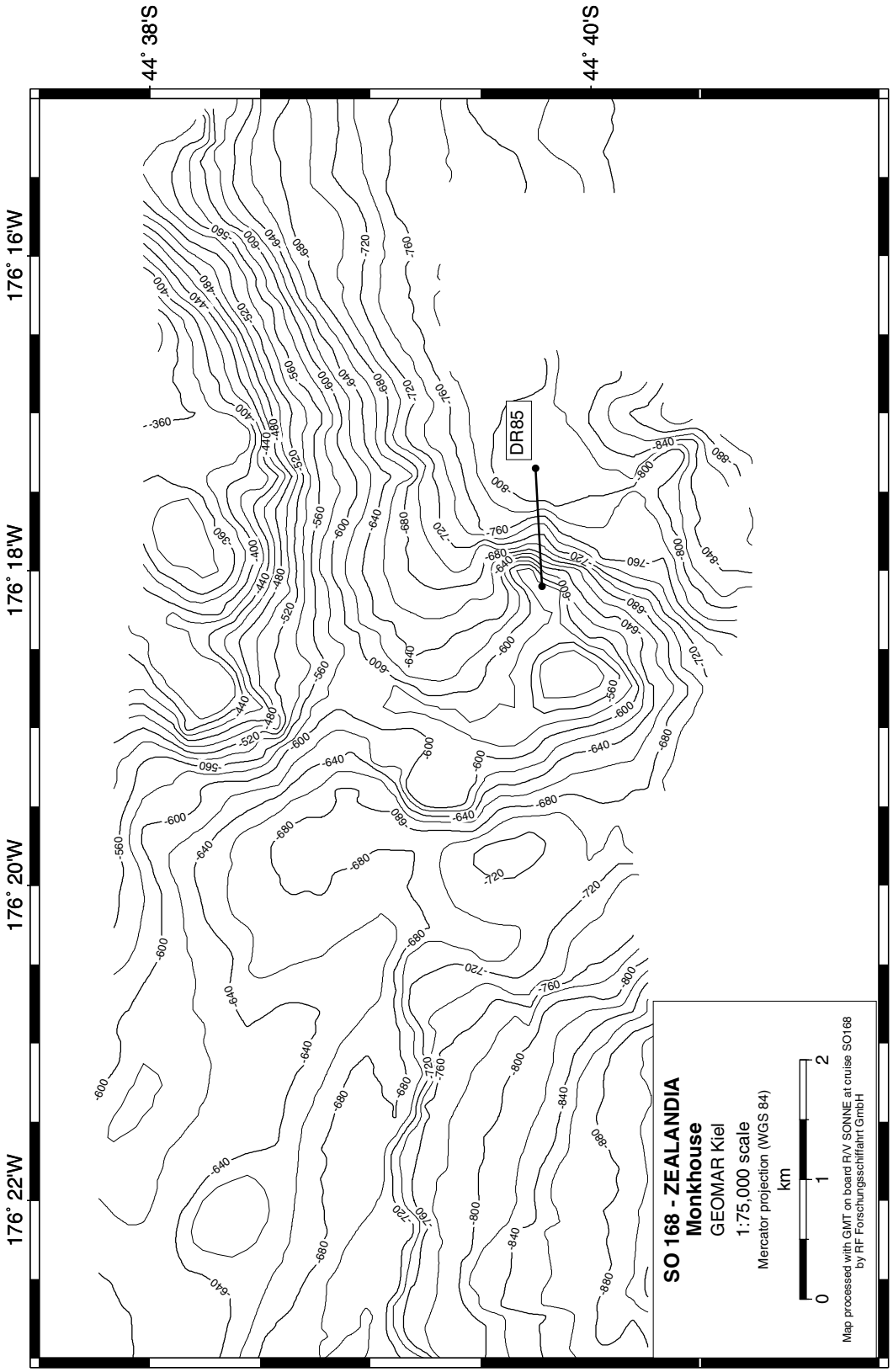

Fig. 6.43.: Bathymetric map of Monkhouse Volcanoes including location of dredge track DR 85.

Thompson (DR 88)

From TOPEX bathymetry, Thompson was identified as a S facing nose in the South Chatham continental slope about 13 km S of Perry. It is outside Wood et al.'s (1989) mapped area and cannot be distinguished from the Perry magnetic anomaly.

Thompson was completely surveyed by SIMRAD EM 120 mapping. Thompson is a circular, 3,5 km diameter hill that juts southward from the Chatham Rise slope to create a pronounced drop in sea floor depth from 1,000 to 1,200 m. In this regard, Thompson is in a similar setting to FBI. The top of Thompson is at 650 m water depth. Two stubby ridges extend ENE and SW from the main top of Thompson, and it is probable that it retains its original volcanic shape. The steep, SW slope was dredged. DR 88 gave altered, amoygdaloidal olivine basalts, some with grey matrices. Volcanic breccias and many high grade metamorphic-plutonic dropstones were also retrieved.

Clerke (DR 89, 90)

Hardcastles Dory Tow is a fishing dredge locality (reported coordinates 44°41'S, 177°20'W) that lies west of Thompson. Several small seafloor outcrops of volcanics are reported west of Pitt and Chatham Islands by Wood et al. (1989). SIMRAD EM 120 mapping showed that the seafloor in all these locations was flat and featureless.

The first dredgable target on one of the Wood et al. (1989) sites was Clerke, about 20 km WNW of the NW tip of Chatham Island. Clerke site consists of two small 300 m diameter hills with tops about 800 m apart. The northern (Clerke A) is 100 m high. The southern (Clerke B) is ridge-like, elongated in a NE-SW direction and has a peak height of 110 m. Dredge DR 89 was made on Clerke A and contained mainly volcanic breccias, some grey with ol and cpx phenocrysts. At Clerke B, the cable broke and a dredge was lost.

Manley (DR 91)

Manley is 55 km N of Clerke and ~60 km NW of the NW tip of Chatham Island. It is interpreted as the largest area of seafloor volcanic outcrop, of Cretaceous to Paleogene age west of the Chatham Islands (Wood et al. 1989).

SIMRAD EM 120 mapping showed it to consist of at least two 50 m high hills in a flat area of 220 m water depth (Fig. 6.44.). The northern one is ~3 km in diameter and the southern one ~0.8 km. North of north Manley, the water depth increases to 300 m; this is the north side of the Chatham Rise. Dredge DR 91 was made on the SW side of the southern hill. The dredge consisted entirely of volcanic breccias, some fresh and it may be possible to extract <1 cm sized clasts for dating and analysis.

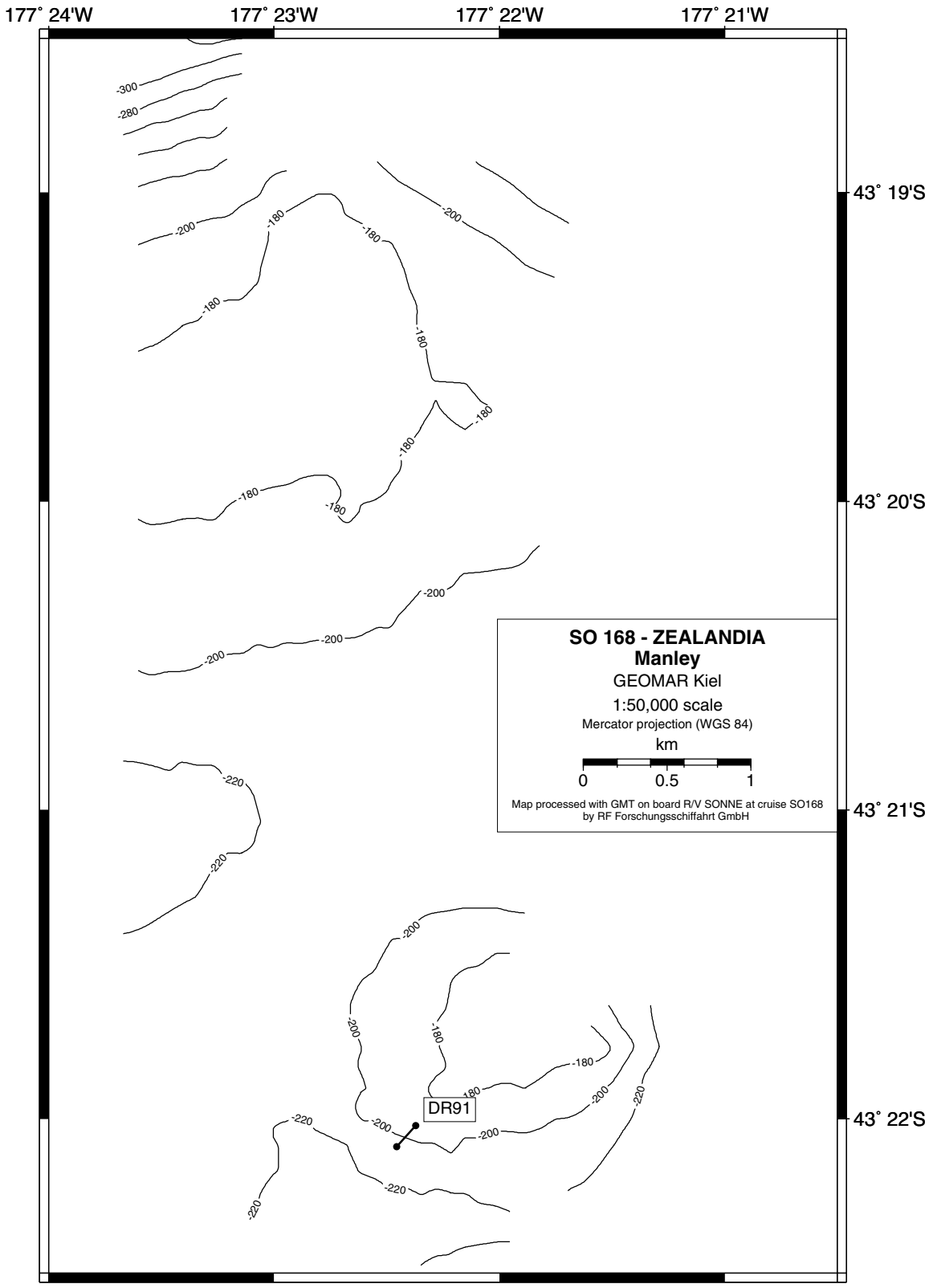

Fig. 6.44.: Bathymetric map of Manley Hills including location of dredge track DR 85.

Chatham Islands Area Summary

The size of volcanic edifices near the Chatham Islands is smaller than the deep water seamounts on the Hikurangi Plateau, in eastern Zealandia and south of the Chatham Rise. Despite the shallow water depths of 100 - 500 m and the lack of time to do more comprehensive mapping, volcanic cones and ridges (probably fault controlled) are abundant in the Chatham Island area and often occur in clusters.

Sparsely olivine-porphyritic vesicular basalt was by far the most common rock type dredged (see Appendix II). Other varieties include clinopyroxene±olivine, cpx+olivine+plag and aphyric basalts. Megacrysts and altered, possibly ultramafic xenoliths were seen in some lavas from Charlton. The basalts from the Chatham Islands area are much less weathered to smectite and much less Mn-encrusted than those encountered earlier in the cruise on the Hikurangi Plateau, though very fresh grey groundmass was only found at Monkhouse and Perry. In almost all cases vesicles are filled with calcite, possibly a result of the near-ubiquitous biological encrustations at these shallow depths.

6.6.2. Western Chatham Rise

In transit west from the Chatham Islands, two areas were targeted for dredging. Haystack was the site of a reported coral mound (Squires 1965) and was a biological target for SO 168; a small seamount was shown on the TOPEX bathymetry map NW of Haystack and it was decided to confirm its existence by SIMRAD EM 120 mapping and then dredge it. Matheson Bank was considered a good target, because Map 12 of Wood et al. (1989) showed 12 sites of dredged lava (these rocks were probably collected by NZOI/NIWA, but this could not be confirmed before the cruise). Matheson Bank also has a weak, broad positive gravity anomaly that would support the presence of volcanic rocks.

Near Haystack, neither the coral mound nor the seamount could be found. There appear to be a large number of bathymetric artefacts on the TOPEX map, where ship track gravity data have been integrated with satellite data. The Haystack area is probably one such artefact. Two dredgeattempts (DR 94, 95) were made on Matheson Bank but were unsuccessful. Slopes on the bank are extremely shallow and only soft sediment was recovered. Despite considerable SIMRAD EM 120 mapping near and north of Haystack and on Matheson Bank, absolutely no structures with a volcanic morphology were found in stark contrast to the Chatham Islands area where volcanic morphologies were ubiquitous.

Graveyard Seamount Complex (DR 3-6)

Located on the north flank of the Chatham Rise near 180° longitude, the Graveyard Complex comprises several individually named seamounts (Rowden et al. 2002). They do not show up on

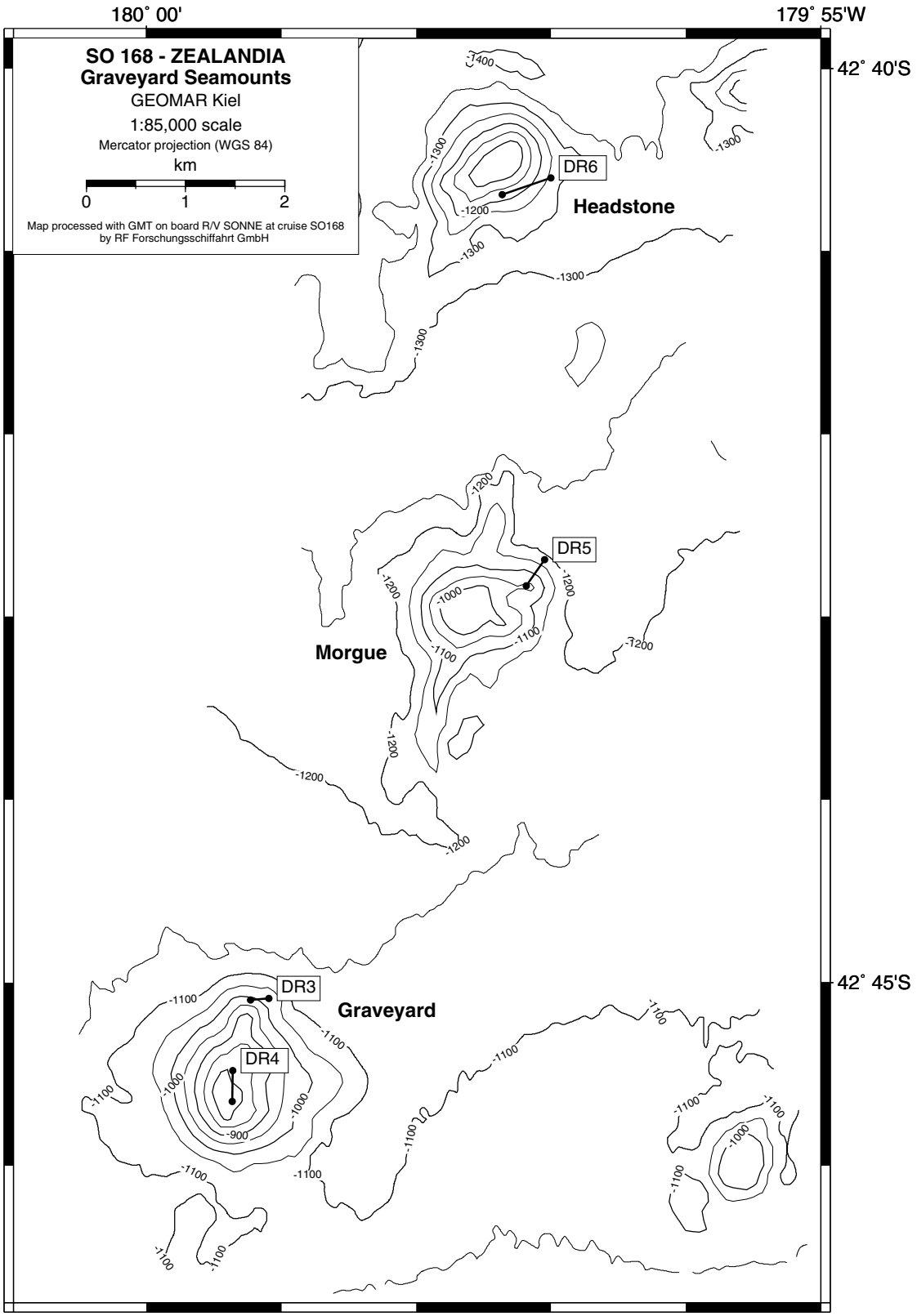

Fig. 6.45.: Bathymetric map of Headstone, Morgue, and Graveyard Seamounts including locations of dredge tracks DR 3 - 6.

satellite-derived gravity or TOPEX bathymetry maps, though Wood et al. (1989) show some small magnetic anomalies and volcanic occurences in the area. Three samples of volcanic and volcaniclastic material had previously been obtained from the area by fishing vessels (NPRC and PETLAB samples P63487, 63494 from Graveyard; P63523 from an un-named seamount); these suggested they would make good rock dredge targets.

SIMRAD EM 120 bathymetry on Graveyard, Morgue and Headstone seamounts revealed all three to be cone-shaped features of volcanic appearance (Fig. 6.45.), seemingly free of significant sediment cover. Graveyard is the largest with a basal diameter of 2 km and height of 330 m. Morgue and Headstone are approximately 1 km across and 250 m high; Morgue (the middle seamount) has ridges extending ~1 km to the NNE and SSW of the main cone. Lavas recovered from DR 3-6 are vesicular olivine basalts. The rarity of zeolites and thinness of Mn rinds is suggestive of a Neogene age for the seamounts while the vesicular, olivine-phyric nature is consistent with alkaline intraplate lineage and/or eruption of lavas in shallow water. Some breccia and limestones were also obtained in the dredges.

Veryan Bank Area (DR 96-99)

The Veryan Bank is a shallow, gently sloping feature, south of the main axis of the Chatham Rise. Water depths are less than 250 m on top of the bank. The positive gravity anomaly over the ~35 km diameter Veryan Bank is about the same amplitude as that over Moore and Palmer. Veryan Bank is also an area of positive magnetic anomalies. All these data, and the reported occurrence of a dredged lava, support a volcanic origin (Wood et al. 1989, Herzer et al. 1989).

Due to bad weather, only the eastern and southern parts of Veryan Bank were surveyed by SIMRAD EM 120. About 15 km ENE of Veryan Bank, a field of small cones was encountered and mapped (Fig. 6.46.). One of these, ***Silke Vulkan***, was dredged (DR 96) and yielded a large quantity of fairly fresh amygdaloidal brown-black ol+cpx phyric basalt. Silke Vulkan and its western neighbours consist of ~800 m diameter, 50 - 200 m high symmetrical cones. Within a 12 km^2 area, there are at least 13 cones. SIMRAD EM 120 mapping revaled the slopes on Veryan Bank to be smooth and most unpromising for dredging. The morphology of the flanks of Veryan Bank were not characteristic of a volcanic structure, such as a guyot. A small cone, ***Orton***, was discovered by SIMRAD EM 120 mapping at the SE base of the Veryan Bank. Orton is similar in dimensions to Silke Vulkan. About a third of the 50 kg of rock dredged from Orton (DR 97) consisted of ol-px and ol-px-hb-phyric basalts, some quite fresh. The other two-thirds was volcanic breccia. This is the only site on the whole of SO 168 where fresh hornblende has been positively identified.

Two other cones, ***Gathrey*** and ***Anja Vulkan*** were surveyed and sampled. These volcanic cones are 4.5 km and 10 km from the SSW foot of Veryan Bank, respectively (Fig. 6.47.), and

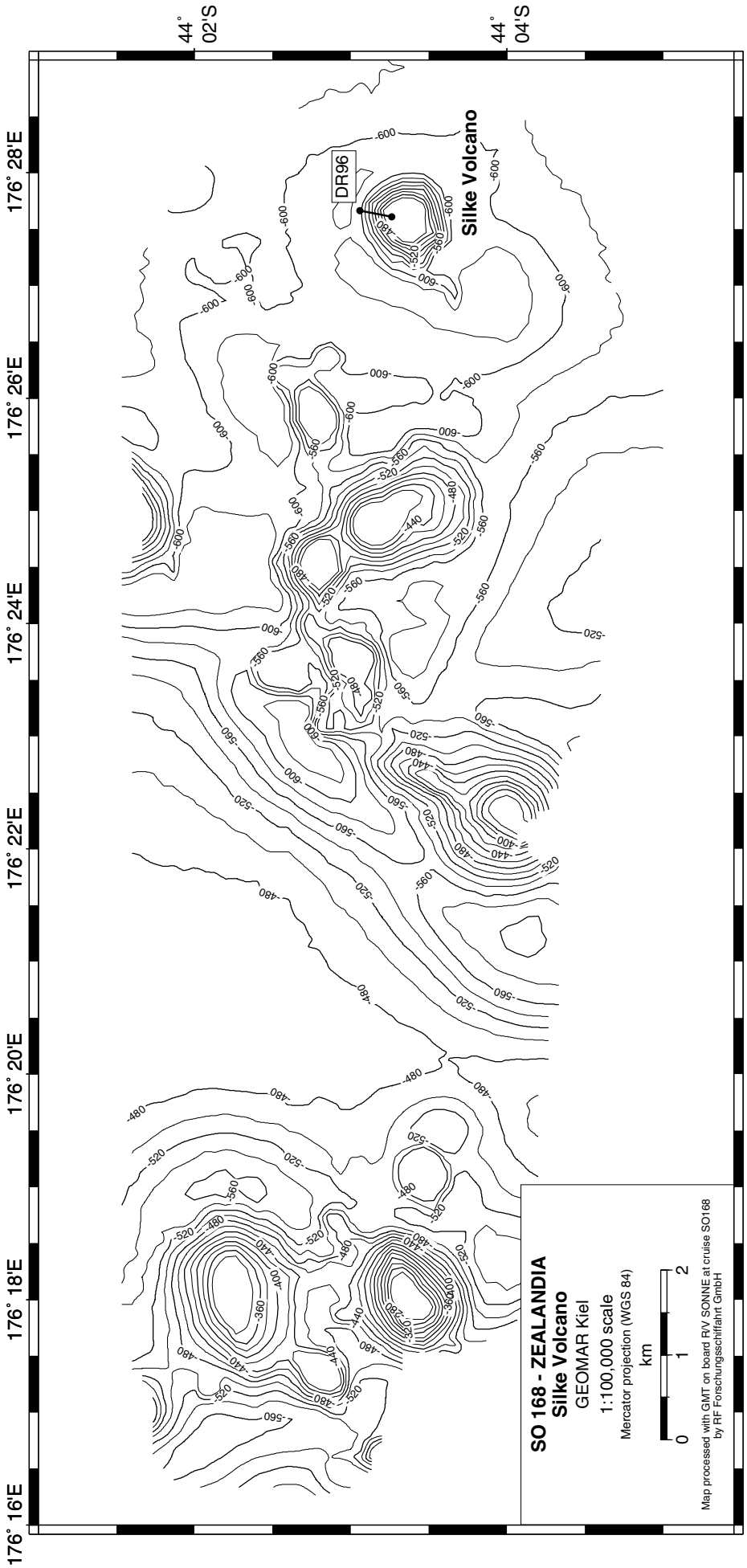

Fig. 6.46.: Bathymetric map of the volcanic field ENE of Veryan Bank including location of dredge track DR 96 at "Silke Vulkan".

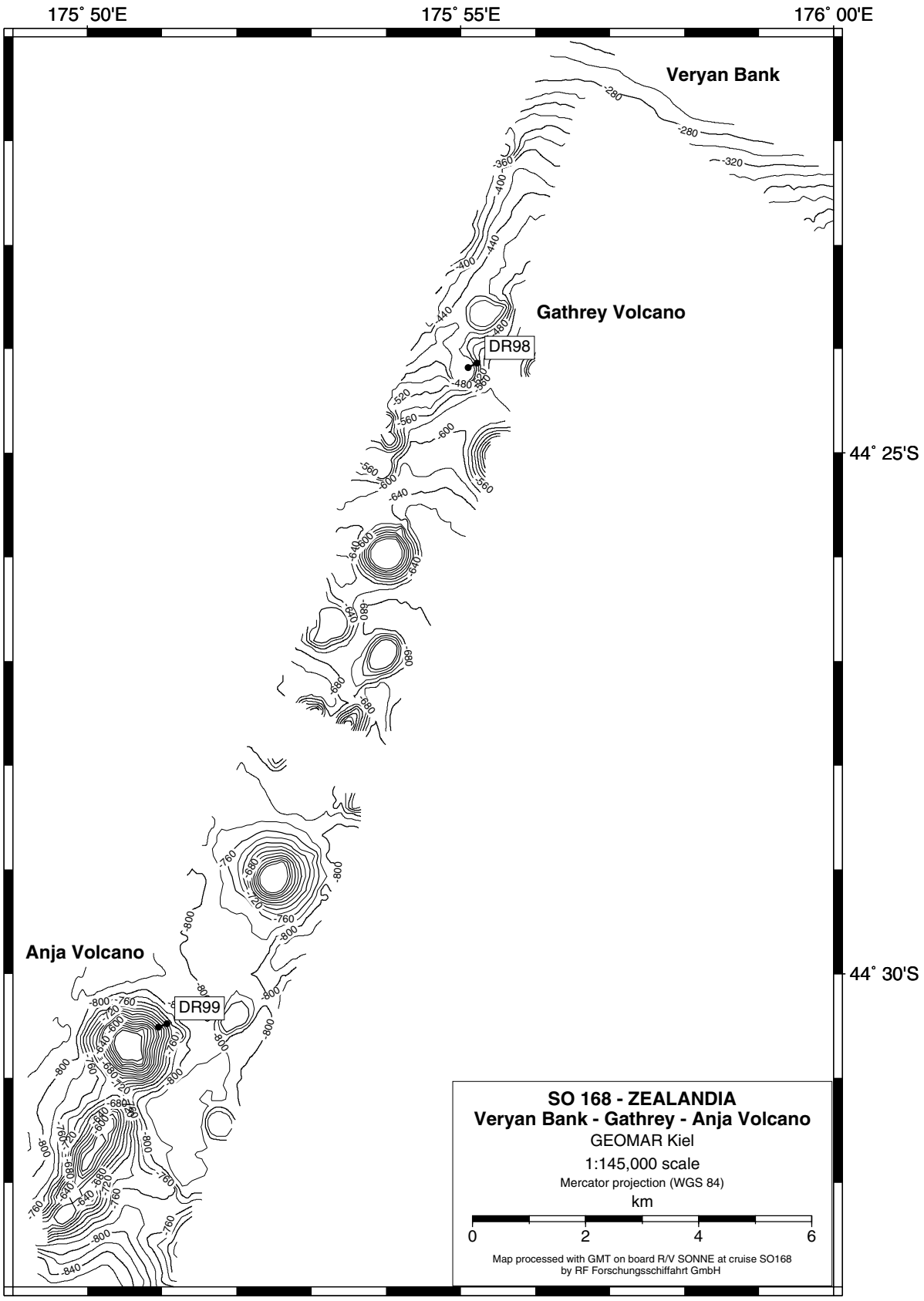

Fig. 6.47: SIMRAD track from Veryan Bank towards SSW across Gathery and Anja Volcanoes. Dredge tracks DR 98 and DR 99 are also shown.

are part of a dense cluster of cones, similar to that on the NE side of Veryan Bank. It is unlikely that Anja Vulkan, Gathrey and the other 10 cones in the surveyed area, represent a radial rift arm from Veryan Bank, even though many of the cones are elongated SSW, because they do not lie on a bathymetric high, as was also the case for Silke Vulkan. The dredge on Gathrey (DR 98) gave a large quantity of fresh olivine-phyric, calcite-amygdaloidal basalts and a few breccias. The dredge on Anja Vulkan (DR 99) was similar in quantity and lithology but the rocks were not so fresh.

Although only a small part of the Veryan Bank could be mapped as a result of the narrow swath at such shallow depths and due to bad weather, the bank itself does not appear to be volcanic. There however appear to be many cones surrounding the base of the bank. The large gravity anomaly may reflect the presence of a shallow intrusion that uplifted the basement to form Veryan Bank, the top of which was probably eroded to a planar surface by wave activity. The many small cones extending up to 10 km from the base of the bank may have tapped this shallow intrusion.

Urry Knolls Area (DR 100-105, TVG 103)

The Urry Knolls were described by Herzer et al. (1989) as an area of scattered volcanic cones of possible Late Miocene to Early Pleistocene age. Three knolls were surveyed in detail and hawaiitite lavas, P46115-46117, obtained from one knoll.

A ~4 x 5 km area of the eastern Urry Knolls was mapped using the SIMRAD EM 120 system (Fig. 6.48.). This revealed a field of ~13 small volcanic cones rising from ~900 m water depth, the tallest being ~300 m high. No linear alignments of cones were visible. A dredge on knoll A of Herzer et al. (1989) was empty. Another dredge (DR 101) on ***Jordan***, 9 km NW contained about 1 kg of rock in the form of a rounded cobble of fresh grey ol-phyric vesicular basalt and a subrounded piece of dark brown altered volcanic breccia. The well-rounded nature of the basalt may suggest it has been transported. A third dredge in the area (DR 102), on ***Reading*** gave only 0.1 kg of rock as a single broken piece of brown zeolite-amygdaloidal olivine-phyric basalt. A nearby TV grab (TVG 103) gave no rocks. In the central region of the Urry Knolls, ***Forwood*** was discovered by SIMRAD EM 120 mapping when in transit to ***Bootie*** (knoll C of Herzer et al. 1989). Dredges from Forwood (DR 104) and Bootie (DR 105) gave large quantities of fresh black olivine-clinopyroxene-phyric basalts.

Summary

The volcanoes of the western Chatham Rise consist of small, scattered cones concentrated into at least four groups (Chatham Islands, Graveyard area, Veryan Bank area, Urry Knolls). Transits between these areas revealed no volcanic fields. Dredges of lavas on Western Chatham

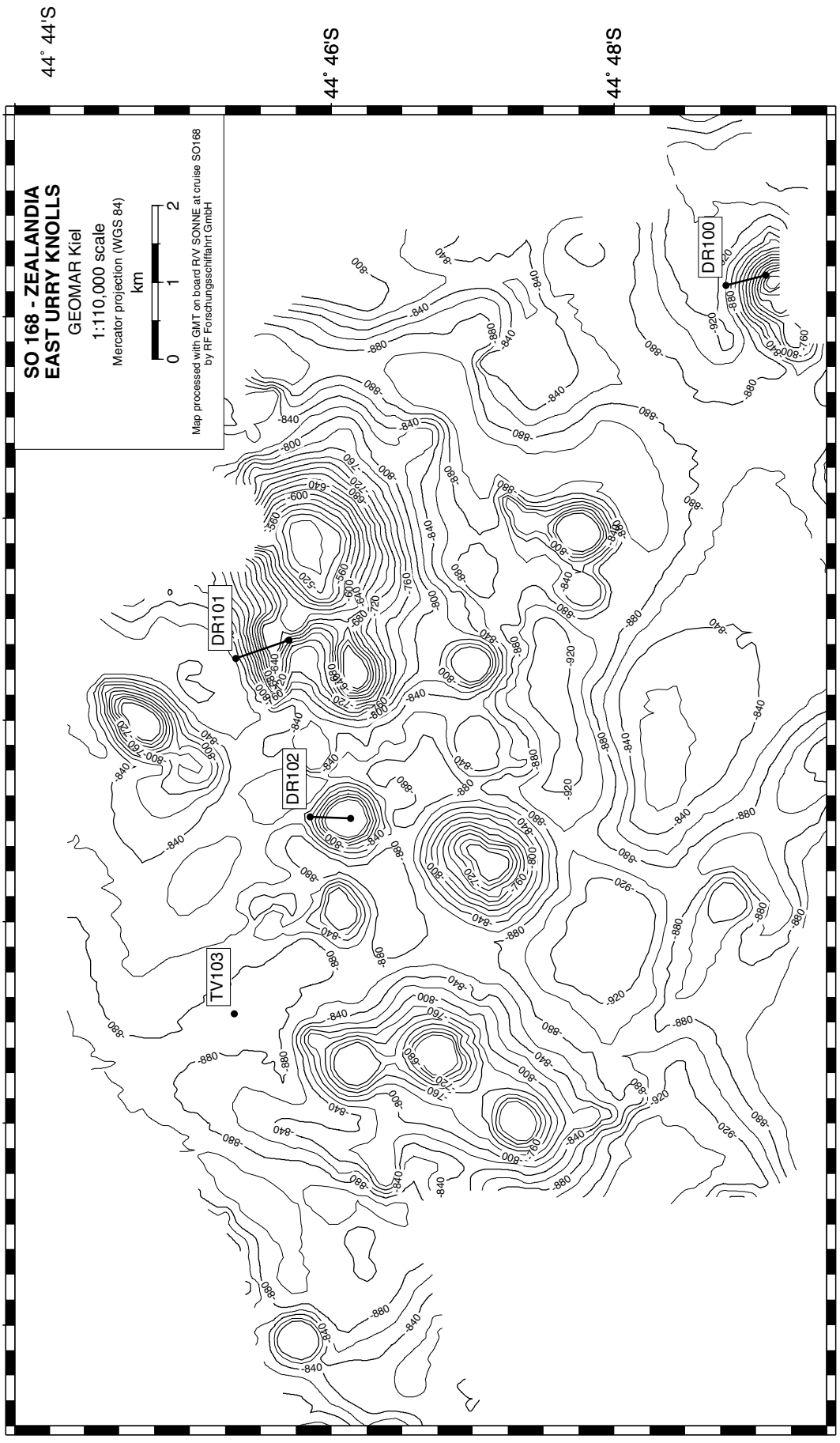

Fig. 6.48.: Bathymetric map of the eastern Urry Knolls including locations of dredge tracks DR 100 - 102 and TV-grab 103.

Rise are dominated by amygdaloidal olivine-phyric basalts. Olivine is almost always altered to clay minerals and/or replaced by calcite. Clinopyroxene accompanies olivine as a phenocryst in many lavas. Fresh hornblende is present with olivine and clinopyroxene in lavas from Orton (DR 97), near Veryan Bank.

7. MANGANESE CRUSTS AND NODULES

Layered manganese crusts are commonly used as geochemical archives for seawater composition. They precipitate from seawater and, therefore, record any variation in the chemical and isotopic composition of the paleo-ocean water.

Tab. 7-1.: Summary of Mn sampling.

Area	#stations with rock recovery	#stations Mn observed	stations Mn collected	max. crust thickness (cm)
Challenger Plateau	2	1	-	1
Hikurangi Plateau seamounts	25	22	9, 11, 12, 13, 15, 18, 21, 23, 27, 32, 41, 42, 46, 47	20
Rapuhia Scarp & deep Pacific seamounts	10	7	38, 43, 45	6
Eastern Zealandia	10	10	54, 57, 59, 60, 61, 62, 63	6
Large seamounts S of Chatham Rise	5	4	65, 67, 71, 72	10
Chatham Islands area	18	2	73	4
Western Chatham Rise (up to Graveyard)	4	2	-	10

At most dredge stations rock surfaces were enveloped by dark brownish-black *crusts* of iron manganese-iron oxide/hydroxide. These varied in size from scattered, uncoalesced nuclei <0,1 mm thick (e.g., Rapuhia DR 34) to epitaxial layers up to 20 cm thick (e.g., Shipley DR 9). Rounded to subrounded manganese *nodules* in which growth has proceeded radially from a central rock nucleus were also observed (e.g., Kakapo DR 61), but not so commonly. The rarest, but most spectacular form of manganese occurrence on SO 168 was in the form of large *boulders* up to 1 m across which (e.g., Palmer DR 23, Savage DR 41), when broken open, revealed a complex history of Mn replacement, growth, brecciation and regrowth. The boulders can be considered as a combination of crust and nodule forms.

In addition to external growth on surfaces, manganese minerals were also seen to have nucleated and grown inside some rocks. In extreme cases there is almost total replacement of the rock with Mn minerals such that only relict detrital or volcanic textures are visible. Mn crusts, nodules and boulders commonly show growth (“tree-ring”) layering parallel to the outer margin of the nodule with layers marked by white or orange clay minerals. Phosphorite is commonly associated with the brecciated internal parts of nodules and boulders. At TV grab station 51 on the top of Polar Bear seamount, a field of scattered, cricket-ball size Mn nodules was seen, half buried in the mud.

8. SEDIMENT SAMPLING

(B. Berning)

8.1. SHIPBOARD PROCEDURE

Soft surface and subsurface sediments were sampled using a TV grab, a box corer, and four sediment tubes installed in the dredges. A small amount of the obtained sediment was taken to produce a smear-slide and then analysed under a stereoscope. A detailed description of the smear-slide samples is given in Appendix IV.

Lithified carbonate sediments and phosphorites obtained with the dredges were cut and screened for fossil/biogenic contents and sedimentary structures using a hand-lens, and classified according to Dunham (1962).

8.2. PRELIMINARY RESULTS

8.2.1. Soft Sediments

At 56 out of the total 94 dredge stations the sediment tubes yielded soft sediment. Furthermore, the sediment obtained at TV grab stations 16, 51, 52, 68 and 103 as well as box corer station GKG 93 was sampled for description. Of these, a total of 39 split samples were taken to produce smear-slides and to describe the sediments in order to assist the biological investigations of the meiofauna.

Four major types of sediment were classified: coral and bioclastic rubble (coarse sediment without mud matrix), foraminifer sand (biogenic components exceeding the amount of micritic matrix), foraminifer ooze (micritic matrix exceeding the amount of biogenic components), and siliceous sponge spicule sand/ooze (foraminifera subdominant or absent). The different sediment types occur within the following depth ranges (N, number of samples):

coral/bioclastic rubble:	from 400 – 600 m	(N = 2), on Chatham Rise only
foram sand:	from 290 – 2,000 m	(N = 9)
foram ooze:	from 1,600 – 4,000 m	(N = 24)
sponge spicule ooze/sand:	from 4,100 – 5,600 m	(N = 4), at Rapuhia Scarp only

The proportion of fragmented foraminifera in the foram ooze sediment samples, which provides the best estimate of dissolution of the calcareous tests (Le and Shackleton 1992), increases greatly with depth and foraminifera are absent from samples below 4,800 m. Although the Hikurangi Channel turbidite system might result in physical fragmentation of the foraminifera, and thus in higher fragmentation values and elevated mud content (Hayward et al.

2002), the transition from foram ooze to sponge spicule dominated sediments at around 4,000 m depth, in concert with the increasing amount of fragmented tests, confirms the depth of the lysocline and the carbonate compensation depth (CCD) to be around 3,500 m and 4,750 m, respectively (Hayward et al. 2002, McCave and Carter 1997).

The biogenic components of the sediment are, in most cases, dominated by planktic foraminifera. The most commonly observed benthic foraminifera include the genera *Cibicides*, *Uvigerina*, *Bolivina* and *Gyroidinoides*. Hayward et al. (2002) discriminate two benthic foraminiferal associations, a bathyal and an abyssal one, which are closely related to the distribution of different water masses. The bathyal association largely parallels the distribution of the Antarctic Intermediate Water (AAIW) which is characterised by a salinity minimum, ranging from ~600 m to 1,500 m. The abyssal association sets in below this depth with the cold Circumpolar Deep Water (CPDW), containing an oxygen minimum and a distinct salinity maximum.

Diversity of benthic foraminifera is highest at Matheson Bank (DR 94, 289-285 m, S-central Chatham Rise) and München Seamount (DR 72, 2268-1979 m, SE of Chatham Is.) where ~27 and 20 species, respectively, were observed in one smear-slide sample. Both stations are located south of the Chatham Rise where the high primary productivity zone of the Subtropical Front (STF) continuously provides the seafloor with organic particulate matter (Hayward et al., 2002). It furthermore corroborates findings by Probert and McKnight (1997) and McKnight and Probert (1993) that benthic biomass of the southern slope of the Chatham Rise, which is bathed by nutrient-rich Subantarctic Surface Waters (SASW), is higher than on the northern side. Interestingly, the sample from Polar Bear Seamount (TVG 51, 1,850 m, SE Hikurangi Plateau) also yielded some 20 species. Current ripple marks and extensive manganese pavements on the top of this seamount indicate strong CPDW bottom currents in this region and depth, obviously providing this site with a steady nutrient supply.

Non-biogenic sedimentary components include glauconite and other authigenic minerals, volcanic fragments, and quartz grains. Glauconite occurs in small amounts on the current-influenced tops of some seamounts, such as Shipley (DR 7 and 8, 1,900 m, western Hikurangi Plateau) and Polar Bear Seamount (TVG 51). It is more commonly found in Chatham Rise sediment samples at depths of about 500 m and can even comprise more than half the total material in some places (Norris 1964). Ash particles and fragments of volcanic rocks are mainly found on the western and central Hikurangi Plateau, presumably deriving from eruptions on the North Island. Small, angular to subangular quartz grains occur in most of the samples west of ~174°W, increasing in abundance towards the Hikurangi Channel and Trough where terrigenous

sediment is deposited by turbidite flows and distributed further to the east by sediment drift (Barnes 1994, Carter et al. 1996).

TV grab and box corer samples showed that the seafloor down to 4,000 m is well oxygenated. The reduction horizon lies several cm below the sediment surface (a more precise estimate can not be given due to disturbance and loss of surface sediment during recovering) and immense bioturbation by holothurians, echinoids and polychaetes destroys the primary stratification. The sediment colour ranges from yellowish grey to light olive grey on the Hikurangi Plateau, changing to greyish olive and pale olive in Chatham Rise samples due to an increasing amount of glauconite.

8.2.2. Fossil Carbonates and Phosphorites

Ancient sediments were occasionally dredged on both the Hikurangi Plateau and the Chatham Rise. Phosphorites mainly occurred on seamounts on the northern slope of the Chatham Rise and on the Hikurangi Plateau in depths between 800 m and 4,000 m. Often, volcanic breccias were found cemented by a phosphatic and/or calcareous matrix, while some nodules act as a nucleus for thick manganese crusts. Larger nodules and plates frequently show hardground features, such as borings, and usually comprise phosphatised mudstones with variable amounts of planktic foraminifera and rare shell fragments.

Major phosphorite formation in the Chatham Rise area took place during the first half of the Late Miocene when Middle to early Late Miocene carbonate hardgrounds and lag deposits were replaced by apatite (Kudrass and von Rad 1984). However, phosphorites from the Hikurangi Plateau have, to my knowledge, not yet been reported. Since most seamounts on this plateau are, based upon findings of foraminifera (Strong 1994), believed to be at least Late Cretaceous in age (Wood and Davy 1994), and since other Late Cretaceous to Paleocene and Oligocene phosphorites occur on the Chatham Islands (Wood et al. 1989), a preliminary age assessment for these rocks can not be made. However, dating of these phosphorites would be desirable not only for paleoceanographic and chronostratigraphic reasons, but also to evaluate growth rates of manganese crusts.

Limestones were, in contrast to phosphorites, mainly obtained at stations south and east of the Chatham Rise from depths between 100 m to 1,800 m. In general, limestones with a micritic matrix, such as mudstones, wackestones and floatstones, are well indurated while grainstones and rudstones are rather weakly cemented and have a high porosity. Their bioclastic components comprise planktic and benthic foraminifera, bivalve shells, echinoid spines, bryozoans, and deep-water coral fragments characteristic of a temperate water environment. Some samples display

hardground features, for example rocks from station DR 82 (510 - 390 m, SE Chatham Rise) are bored by subrecent *Lithophaga*, the shells of which are preserved *in situ*.

Ancient sediments of the Chatham Rise and Hikurangi Plateau area have mainly been studied and interpreted using seismic stratigraphy (Wood et al. 1989, Wood and Herzer 1993, Wood and Davy 1994) or deep-sea drilling (Carter et al. 1999). However, very few information (Norris 1964, Cullen 1965, Lewis and Bennett 1985, Strong 1994) exist on fossil limestones and their age, depositional environment, paleontology, or diagenesis.

The Hikurangi Plateau is covered by Mesozoic (presumably mid- to Late Cretaceous) to Recent pelagic sediments (Wood and Davy 1994) which can be correlated with sedimentary successions on the Chatham Rise (Wood et al. 1989). On the rise, Maastrichtian to late Paleogene shallow water to bathyal sediments are followed by a condensed succession of limestones and greensands with slow sedimentation rates and erosional unconformities of latest Paleogene to Neogene age (Wood and Herzer 1993). Many of these sediments can be correlated with limestones cropping out on the Chatham Islands and the South Island (Norris 1964). Ages of the limestones obtained on this cruise are assumed to range from Pleistocene (very weakly cemented mudstone with preserved shell colours, DR 78) to Paleogene (as inferred from the planktic foraminiferal assemblage, DR 80). A more precise dating will aid in establishing the times and areas of carbonate production and sediment deposition between the South Island and the Chatham Islands during the Cenozoic.

Another interesting aspect of Chatham Rise seamounts and their sediments concerns the destructive diagenesis and cementation of calcareous sediments in non-tropical waters: most of the seamounts dredged were not exposed to meteoric diagenesis during the Neogene sea-level lowstands. However, all samples showed some degree of cementation, yet circumstances of aragonite dissolution and precipitation of cements in these cool corrosive waters are still a subject of much debate (Nelson and James 2000). Thus, analysis of the varying degrees of cementation of the obtained mudstones and floatstones will shed light on marine sea-floor diagenesis and cementation of limestones in the temperate realm.

9. BIOLOGY

(B. Neuhaus, C. Lüter, B. Berning, J. Hoffmann)

9.1. SHIPBOARD PROCEDURE

The sites for the 6 biological stations 16-17, 51, 52-53, 68-69, 92-93, and 103 were preliminary selected on the basis of the TOPEX database maps. At the site, the ocean floor was checked for absence of rocky surface and flatness with PARASOUND and SIMRAD EM 120 profiling; the latter allowed visualization of the ocean floor at depth line intervals of 10 m. The ocean floor was then inspected by the TV grab on a transect of about 200 m in length.

At the 6 biological stations, sampling was facilitated by a TV grab and a box corer (core size: 50 cm x 50 cm), in order to obtain a large amount of surface sediment which is generally most densely inhabited by the fauna. This gear was used once at each station. The box corer offered the advantage to receive surface sediment less disturbed than in the TV grab.

9.1.1. Meiofauna

Sediment sampled by four sediment trap tubes (length: 21 cm, diameter: 4 cm) inside the chain bag dredges was fixed immediately in cold 6% formaldehyde buffered with buffer tablets for haematology (Merck). After at least one day of fixation, the sediment was washed carefully with plenty of tap water on a 40 µm-sieve and centrifuged (KENDRO Heraeus Multifuge 3s) three times for 5 minutes with three times the amount of Levasil 200A/40% at 4,000 rpm in order to quantitatively extract the meiofauna. After rinsing with tap water on a 40 µm-sieve, specimens were stored in 75% ethanol.

Sediment was sampled with the TV grab together with macrofaunal specimens whenever possible. The entire haul from the TV grab was carefully checked for additional macrofaunal organisms buried in deeper layers of the sediment. About 2-7 kg of near-surface sediment were fixed in cold 6% formaldehyde and processed as described above. From the box corer, only the upper 5 cm of sediment were taken. Samples were split into two portions: About 1-2 kg of sediment were fixed immediately in 1.5% formaldehyde plus 3.75% glutardialdehyde in cacodylate buffer for electron microscopy. This material was later washed with tap water on a 40 µm-sieve, centrifuged for meiofauna, and stored in 0.1 M cacodylate buffer with some fixative added to prevent mould during transportation. About 6-8 kg of additional sediment were fixed in cold 6% formaldehyde and processed as described in the previous paragraph.

The TV images were recorded on video tape and later analyzed for the structure of the sediment surface and for the benthic animal community.

9.1.2. Macrofauna

The main source for the macrofauna were hard rocks, harvested with the chain bag dredge. The organisms were collected from the rocks with the help of forceps, scalpels, and chisels if necessary. Since larger organisms were most often abraded from the rock surface before they came on board, the majority of usable biological material was found in holes and crevices of the rocky substrates and only occasionally larger organisms were encountered as trapped between the rocks or in the chain bag itself.

Representative rock surfaces with inhabitating fauna as well as individual macrofaunal specimens were documented on Kodak elite chrome 100 slides with a Minolta X-700 camera, a macro flash Minolta PX 80, a Tamron SP 1:2.5/90 mm macro lens, and a Tamron SP 2x converter. Macrofauna collected from rocks (and to a smaller extent from sediment) was immediately fixed in 4% buffered formaldehyde (see above), rinsed in tap water twice after at least 24 hours, and transferred to 75% ethanol. Brachiopoda and occasionally specimens of other animal groups were fixed in 96% pure ethanol in order to facilitate genetic studies at a later time. Except for the later stations, all specimens were investigated and sorted in the biological laboratory of RV “Sonne” under the stereo microscope.

9.2. PRELIMINARY RESULTS AND DISCUSSION

From 96 geological dredge hauls, 61 were successfull for sediment and 72 hauls for macrofauna. All 6 TV grab stations revealed both sediment and macrofauna, only 2 out of 4 box corer stations yielded sediment and a single station macrofauna. About 20 kg of sediment were collected by the sediment traps during SO 168 and preserved for light microscopical investigations. Additional 45 kg of sediment from the TV grab and box corer stations were saved for light microscopical and 6 kg for electron microscopical studies. All station locations and biological samples are listed in Appendix V.

9.2.1. Meiofauna

The sediment samples from the dredge and biological stations revealed species from most marine invertebrate groups of the animal kingdom, and demonstrated the diversity of animal life on the summit and at the flanks of Hikurangi Plateau and Campbell Plateau seamounts and on Chatham Rise. During the cruise, samples from 23 of 69 hauls (geological dredge, TV grab, box corer) yielding sediment were pre-sorted for meiofauna, 2,176 specimens of the meiofauna were isolated already. Further sorting at Berlin is expected to reveal many more specimens, since it is rather difficult to trace especially the smaller sized meiofauna groups such as Kinorhyncha,

Loricifera, and Tardigrada with a stereo microscope at magnifications of 30x on board of a moving ship.

Foraminifera and Nematoda outnumbered by far all other meiofaunal groups followed by the Copepoda and Annelida. Specimens of several other taxa have been recovered occasionally in the pre-sorted samples. Tardigrada were found at stations between 2,600 m and 4,100 m depth, Kinorhyncha (probably genus *Echinoderes*) between 1,000 m and 1,800 m depth, and Loricifera between 1,000 m and 3,000 m depth. However, samples from shallower locations have not been checked for meiofauna yet.

Regularly, worm-like organisms were discovered but could not be identified with certainty under the stereo microscope. Probably, these animals belong to the Gastrotricha and Plathelminthes. Both groups are rarely reported from the deep sea (Higgins and Thiel 1988).

Surprisingly, one insect and one parasitic mite appeared in the samples. The insect is preliminarily assigned to the Mallophaga which generally parasitize the feathers of birds feeding on keratin-like substances. Probably, both the insect and the mite originated from sea birds and accidently left their hosts.

The high number of meiofaunal specimens found in the sediment samples on this cruise is due mainly to the increased number of 4 sediment traps mounted in each geological dredge and to the extensive usage of the density centrifugation method. This latter technique is supposed to recover meiofaunal organisms quantitatively from any kind of sediment be it mud or deep-sea clay or sand (Higgins and Thiel 1988). Only the KENDRO Heraeus Multifuge 3s with its large centrifugation volume of 4 x 600 ml (taking 4 x 150 ml of sediment) allowed to process the enormous amount of about 60 kg of sediment on board of RV “Sonne” in a reasonable amount of time.

9.2.2. Macrofauna

Benthos

Porifera were the most common organisms in the probes, followed by Bryozoa, Polychaeta, and Brachiopoda. Porifera and Bryozoa exhibited the richest diversity in size, morphology, and internal organisation. Porifera grew as spherical organisms or plaque-like with an irregular border or more or less perfectly round on the rocks’s surfaces; body size varied considerably between a few millimeters and about 20 cm; they appeared slimy, exposed long needles, or showed a rough surface; colours varied from bright yellow to bright red, greenish, violet, browny, or whitish. Bryozoa exhibited zooids growing in lines, as irregularly bordered plaques, or raising above the surface with a little stem.

As expected, macrofaunal organisms were found in high numbers and diversity on the Chatham Rise at stations with maximum depths down to about 600 m. Several dredges contained mainly cold water adapted reef corals such as *Goniocorella* cf. *dumosa*, which themselves provided a perfect habitat for all sorts of vagile invertebrates, like polynoid and nereid Polychaeta, Ophiuroida (brittle stars), Cidaridae (pencil sea urchins), Asteroida (sea stars) und galatheid crustaceans.

The sample from station 89 at a depth of 80 m revealed a single large boulder (ca. 60 x 50 x 40 cm), completely encrusted with suspension feeders such as Porifera, Bryozoa, Tunicata (sea squirts), arcid bivalves, and tube-building serpulid polychaetes. The tubes of the latter consisted of calcium carbonate offering a good protection against disturbace from the environment. Bryozoans were often stalked, probably, in order to elevate above the completely encrusted surface of the rock and to have easier access to food particles. Small holes and crevices partly built by the epizoic organisms themselves were crowded with amphipod and galatheid crustaceans, nemertean and sipunculid worms, and polychaetes. These polychaetes secreted a matrix for their tubes in which sediment particles were embedded. Such tubes as well as their inhabitants were found both on Chatham Rise and in the deep sea.

Bright green echiurid worms were found repeatedly at stations on Chatham Rise but not in the deep sea. Each specimen (body length 10 - 15 mm) hid in small crevices of a rock or between corals and extended its elongate proboscis (length ca. 3 - 5 cm) with its bifurcated tip over the surface of the rock and coral, respectively. Supposedly, the proboscis was used to search for small food particles.

9.2.3. Plankton

Regularly at night, planktic, 2 - 40 cm long salps (colonies of tunicates) were observed near the water surface and recovered by the geological dredges. Video observations with the TV grab at daytime revealed theses salps at depths of 400 - 600 m but not at the surface of the ocean. It is therefore concluded that the salps migrate daily between the surface and deeper water layers of the Pacific.

Quite frequently, ~2 cm long juveniles of the Portuguese Man'O'War (*Physalia* sp.) got entangled in the dredge wire. Whereas juveniles of this size possess over 1.5 m long tentacles for catching their prey, tentacles of 30 cm large adult grow up to 50 m long; their stinging capsules contain a toxine which is live-threatening for humans. Fortunately, the juveniles could be touched without harm.

9.2.4. TV-Observation of the Sea Floor

The use of the TV grab offered one possibility to directly observe the deep-sea bottom and its visible macrofauna at a specific station. For technical reasons the use of the TV grab was restricted to flat areas preferrably without rocks but covered with sediment. At each biological station, the TV grab moved slowly over ground for a period of about 20 minutes and a distance of ~200 m, which allowed to get a general impression of the properties of the locality. Animal life at the 6 stations was very different. Especially the two stations 51 and 52 on one and the same seamount offered a contrasting picture. Station 51 at 1,840 m depth on the summit of the seamount was characterized by patches of rock surface without sediment coverage and rippled sediment surface with coarse sandy sediment indicating relatively strong permanent underwater currents. If the small weight in front of the TV grab hit the ocean floor, the fine sediment particles immerged into the water column and immediately drifted away in a preferred direction. However, at station 52, although located just 110 m deeper than 51, a smooth sediment surface was observed covered by muddy particles which did not drift away for a long time and therefore showed no signs of permanent underwater currents.

On the summit of a seamount at a depth of 3,900 m (station 68), the TV grab revealed fine sediment deposits, many openings of polychaete burrows, small sediment mounts, sea stars, and elasipodid holothurians. The latter used their elongated tube feet to walk on the ocean floor. Possibly, burrowing holothurians may be found below the sediment mounts.

10. DEEP WATER CORALS AND CNIDARIAN REEFS

(S. Noé)

10.1. INTRODUCTION

On SO 168 cruise, dredge hauls deployed along the southern margin of Chatham Rise provided two extended modern deep-water reefs consisting of a stylasterid/coral association or an azooxanthellate scleractinian coral community respectively. Both of these large reef complexes reveal a vertical zonation of living thickets, dead specimens, and rubble from top to base. Furthermore, a gorgonian patch reef was dredged on the southwestern Chatham Rise. In addition, several fossil coral occurrences scattered on seamounts of the southern Hikurangi Plateau region were detected in dredge samples. The general term “reef” is used for the modern coral and stylasterid occurrences, because the discoveries result from dredging and echosoundings solely which did not provide sufficient data to specify those deep water buildups according to morphology and internal construction.

10.2. METHODS

Calcareous coral and stylasterid skeletons were stained with a solution of 1g rose bengal in 1l ethanol in order to distinguish dead specimens (remain unstained: white to cream-coloured) from live, actively metabolising polyps (pink to red staining colours). Surface sediment samples recovered by TV grabs and box corer deployment at 5 biological stations were sieved through 250 µm, 125 µm and 63 µm net sizes. Siliciclastic and carbonate particles were identified from the residues of each grain size, planktic/benthic foraminiferal ratios were estimated, and a preliminary identification of foraminifera was carried out under a low-magnifying binocular (Appendix IV). CTD casts carried out on the southern and northeastern Hikurangi Plateau and on the northeastern Chatham Rise provided data to physical properties of water masses comprising the depths at which living cnidarians were discovered on southern Chatham Rise (Chapter 10.4.3.).

10.3. RESULTS: DISCOVERIES OF MODERN CNIDARIAN REEFS ON CHATHAM RISE

10.3.1. Southeastern Slope of Chatham Rise

Stylasterid / Coral Reef at Western Uprises and Chapman´s Hill East of Chatham Island

Two dredge hauls carried out east of Chatham Island along the slope of Western Uprises and Chapman´s Hill at 600 to 900 m water depth recovered the dead and overlying living part of a

stylasterid / coral reef with a lateral extent of at least a few kilometers. The reef is predominantly composed of calcifying colonial stylasterid hydrocorals (Fig. 10.1.) and azooxanthellate commensal scleractinian corals. The most common species of the white, pink, red or reddish-brown uniplanar stylasterids, *Errina chathamensis* CAIRNS, is characterized by robust uniplanar arborescent skeletons with a dense massive basal branch and 2-4 divergent major branches which give rise to numerous small branches filling the flabellum (Cairns 1991, Figs. 10.2., 10.3.). In addition, *Errina sinuosa* CAIRNS, *Stylaster eguchii* (BOSCHMA), *Lepidopora dendrostylus* CAIRNS, *Calyptopora reticulata* BOSCHMA, *Lepidotheca fascicularis* (CAIRNS) and *Conopora laevis* (STUDER) were found subordinately. This “Chatham Rise assemblage” represents a generalised fauna of low endemicity (Cairns 1991).

On the other hand, anastomosing or bushy *Madrepora* colonies represent compound corals living in symbiosis with commensal polychaetes forming tube galls throughout the corallum (Cairns 1995; compare Figs. 10.13., 10.14.). Stylasterid and scleractinid colonies amalgamate to form low-relief thickets over the sea floor.

The associated reef community consists of soft corals, hydroids, demosponges, hexactinellid sponges, bryozoans, bivalves, tunicates, serpulids, polychaetes, ophiuroids, and crinoids (Fig. 10.1.). Rare specimens of living solitary scleractinians (*Flabellum*) and of dead gorgonian octocorals (*Isidella*) are restricted to the deeper part of the reef that is predominantly composed of dead stylasterids.

Fig. 10.1.: Rubble of living cnidaria recovered by dredge haul with stylasterid fragments (white), *Madrepora* fragments, purple soft corals, chitinous hydroids, demosponges, polychaetes and ophiuroids. Reef east of Chatham Islands. Width of image measures 80 cm.

Fig. 10.2.: Live stylasterid colonies (*Errina chathamensis* CAIRNS). Note short basal branch dividing into 3-4 divergent major branches which in turn divide into numerous smaller non-anastomosing branches that fill the flabellum. Stylasterid reef east of Chatham Islands. Width of image measures 20 cm.

a) **b)**

Fig. 10.3.: (a) *Errina* fragment stained with rose bengal, showing one living branch (red staining colour, here shown in gray) of an otherwise dead colony (whitish). Stylasterid reef east of Chatham Islands. Width of image measures 12 cm. **(b)** Stylasterid fragments stained with rose bengal. Live specimens (red after staining) are shown in light to medium gray, dead specimens on upper right (unstained, brownish skeletons) are shown in dark gray. Stylasterid reef east of Chatham Islands. Width of image measures 25 cm.

Staining with rose bengal provided evidence that some stylasterid specimens are live in one or a few branches only, while major part of the colony is dead (Figs. 10.3a, b). While the aragonitic skeletons of live specimens are well preserved, dead stylasterid specimens (Fig. 10.3b) and

gorgonians are heavily bored by *Lithophaga*, sponges and epibenthic microorganisms (bacteria, fungi). Progressive bioerosion resulted in breaking off entire branches and eventually in disintegration of the skeletons to rubble.

Scleractinian coral reef on the continental slope south of Chatham Island

A large reef complex extending over a lateral distance of more than 11 km was recovered from four dredge hauls at 450 - 700 m depth south of Chatham Island (Jones Seamount and Perry volcanic area). It reveals a vertical zonation of azooxanthellate scleractinian corals as follows (from base to top): **1.** coral rubble zone; **2.** zone of dead thickets of the colonial scleractinian *Goniocorella dumosa* YABE & EGUCHI forming a bushy anastomosing network by extratentacular budding; these colonies are associated with solitary corals whose individual coralla are sometimes clumped into quasicolonies (Fig. 10.5.): **a)** *Flabellum knoxi* RALPH & SQUIRES: predominantly dead specimens attached to *Goniocorella dumosa* (Figs. 10.5., 10.6.); **b)** *Desmophyllum dianthus* (ESPER): living specimens growing on *Flabellum* (Figs. 10.5., 10.6.) and on *Goniocorella*; **3.** living coral zone of *Goniocorella* colonies (Fig. 10.4.) with few associated stylasterids and solitary corals (*Flabellum, Desmophyllum*). The delicate *Goniocorella* colonies forming low-relief thickets and coppices on the sea bottom are stabilized by the heavily calcified solitary scleractinians reaching up to 66 mm in height and 128 x 54 mm in calicular diameter. Since the *Goniocorella* skeletons readily break down into fine-grained sediment, they act as sediment formers rather than as framework builders.

Fig. 10.4.: Live colony of Goniocorella dumosa YABE & EGUCHI with attached hydroids, sponges and other soft-bodied biota. Ree south of Chatham Islands. Width of image measures 18 cm.

Fig. 10.5.: Dead solitary scleractinians:. *Flabellum knoxi* RALPH & SQUIRES, sometimes colonized by *Desmophyllum dianthus* (ESPER) (arrow). Reef south of Chatham Islands. Width of image measures 12 cm.

Fig. 10.6.: Coral growth successions: *Flabellum knoxi* growing on *Goniocorella dumosa* (left); *Desmophyllum dianthus* (arrow) growing on *Flabellum* (right). Reef south of Chatham Islands. Width of image measures 10 cm.

The white or brownish *Goniocorella* colonies occur in several taphonomic stages through the reef: **1.** live corals; **2.** living and dead parts within one colony, but well preserved skeletons; **3.** slightly fragmented skeletons. Heavily fragmented coral rubble was found at the lowest part of the reef only.

Benthic fauna associated with the living corals includes soft corals, octocorals, pennatulids, hydroids, a great variety of sponges, bryozoans, tunicates, polychaetes, serpulids, annelids, ophiuroids, echinids and molluscs. In addition to the solitary corals, encrusting bryozoans and sponges contribute to the stability of the *Goniocorella* thickets.

10.3.2. Southwestern Margin of Chatham Rise: Gorgonian Patch Reef

Several dredge hauls deployed on the southwestern margin of Chatham Rise around Veryan

Bank and Urry Knolls mainly provided eroded trunks of stylasterids and some tiny scleractinians attached to volcanic rocks or semi-lithified skeletal carbonates; all of the specimens found were dead.

On the other hand, one dredge haul recovered a patchy occurrence of living gorgonian octocorals (*Isidella elongata*) in the Urry Knolls area. Anastomosing branches of the gorgonian skeletons are up to a few decimeters long, showing a typical alternation of white calcified internodia and dark horny nodia (Fig. 10.7.). The gorgonian skeletons are intensely colonized by soft corals sequestering gelatinous slimes (Fig. 10.7.). Demosponges, encrusting bryozoans, hydroids and polychaete worm tubes act as biological stabilizers of this patch reef, while ophiuroids and molluscs are the most common dwellers. In addition, the dredge haul provided a dead gorgonian specimen of 50 cm in lateral diameter with simple dichotomous branching, showing numerous borings and microbial encrustation (Fig. 10.8.). The internal structure is characterized by concentric growth rings. Such massive, heavily calcified octocorals may have formed the base of the patch reef that subsequently became colonized by delicate *Isidella* colonies.

Fig. 10.7.: Live gorgonians (Isidella) colonized by soft corals (purple) sequestering gelatinous slimes. Note alternation of calcified inernodia and horny nodia. Southwestern part of Chatham Rise. Width of image is 15 cm.

Fig. 10.8.: Dead isidid gorgonian, heavily bored by Lithophaga and endolithic micro-organisms and colonized by hydroids. Southwestern part of Chatham Rise. Width of image measures 25 cm.

10.3.3. Chatham Rise Plateau

The preliminary survey of deep-water reef-building cnidaria obtained on SO 168 did not provide any buildups on the Chatham Rise plateau in water depths between 100 to 550 m. Though several occurrences of corals and stylasterids are reported by Cairns (1991, 1995), and distinctive carbonate mounds are described by Squires (1964) from two localities north of Matheson Bank, careful SIMRAD EM 120 mapping across these areas did not resolve any mound-like structures. Accordingly, dredge hauls around Matheson Bank as well as a TV grab deployed at one of Squires´ coordinates NNE´ of this bank provided foraminiferal/skeletal sands covering early Cenozoic bioclastic limestones only, lacking any coral or stylasterid debris.

10.4. DISCUSSION: OCEANOGRAPHIC CONTROLS OF MODERN DEEP WATER CNIDARIAN REEFS ON CHATHAM RISE

10.4.1. Controls of Azooxanthellate Scleractinian Coral Growth

Like non-symbiotic stylasterid hydrocorals which show a wide depth distribution from shallow-marine areas down to 3,000 m and a temperature range from warm-temperate to subpolar regions, living azooxanthellate scleractinian corals occur within a large bathymetric range from levels below the photic zone and storm wave base down to 6,200 m depth, and within a temperature range of -1°C to 29°C (Freiwald 2002). In contrast to their zooxanthellate counterparts these corals are cosmopolitan, occurring in continental shelf, slope, deep-sea and isolated seamount settings, wherever sufficient organic particle food supply to the sea floor is ensured.

The well-studied mound-forming azooxanthellate deep-water corals of the cold-temperate realm in the North Atlantic are tied to **1.** homotherme and homohaline water masses, i.e. beneath the influence of saisonal fluctuations (4 - 12°C, 35 - 37‰), and **2.** high hydrodynamic energy which may be provoked by internal waves on the shelf margin, benthic storms or topographically focused currents in form of eddies, barotrophe tides or boundary currents which can a) concentrate sinking plankton and organic particles at certain water depths by maintaining the nutrient flux rates to the heterotrophic corals, b) exchange water masses, and c) prevent deposition of fine-grained detritus on the corals and on the hard substrata the *Planula* larvae use to settle on (outcropping volcanic and sedimentary rocks, loose boulders, dropstones, clams) (Freiwald 2002). In addition, *Lophelia pertusa,* the most wide-spread reef-forming azooxanthellate scleractinian species of the North Atlantic, prefers oxygen-depleted water masses and hence flourishes in the oxygen-minimum zone (Freiwald 2002).

10.4.2. Hydrography of the Chatham Rise Area

Oceanic Fronts

The surface water on the Chatham Rise is controlled by the Subtropical Convergence (STC) which comes around the south of South Island and continues eastward along the Chatham Rise crest at 44° latitude. It is bound by two eastward currents along which sharp lateral temperature and salinity gradients of surface waters associated with strong mesoscale eddies are observed (Nelson et al. 1993). The STC separates warm (summer temperature >15°C, winter temperature >10°C), high-salinity (35.7 - 35.8‰) Subtropical Water (STW) in the north from cooler (<14.5°C summer temperature), less saline (34.5‰) Australasian Subantarctic Water (ASW) in the south (Fenner et al. 1992). The Subantarctic Front (SAF) with 8°C surface temperature and 34,5‰ salinity separates the ASW from the Circumpolar Subantarctic Water (CSW) in the south (Weaver et al. 1998). The SAF follows the eastern flank of Campbell Plateau to 50° latitude.

Water Masses

The Chatham Rise occurs within a dynamic oceanographic regime involving Subtropical/Subantarctic surface water (0 - 80 m depth), Subantarctic Mode Water (SAMW: 80 - 600 m depth, reaching the ocean bottom of the Chatham Rise plateau) and Antarctic Intermediate Water (AAIW: 600 m down to sea floor of the northern Hikurangi Plateau). Pacific Deep Water (PDW) which is entrained within the Deep Western Boundary Current (DWBC) flowing northward along the eastern contours of the Campbell Plateau, Chatham Rise and Hikurangi Plateau occurs below 3000 m depth (Fenner et al. 1992).

10.4.3. CTD Casts from the Southern Hikurangi Plateau

CTD casts carried on the southern and northeastern Hikurangi Plateau and on the northeastern Chatham Rise down to 2,000 m depth provided data to the physical properties of the Subtropical Surface Water (STW), Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW). The diagrams of all measured sites document a thermohaline density stratification which has well established during early summer. In the following, the CTD casts from the southern Hikurangi Plateau (41°56.419´S, 179°34.858´W, depth 2,553 m) are briefly described (Figs. 10.9. – 10.12.).

Temperature

Temperature continuously decreases with increasing water depth from 14.8°C at the surface to 2.3°C at 2,000 m depth (Fig. 10.9.). The diagram reveals a thermocline at about 100 m, documenting the boundary between the surface water and the Subantarctic Mode Water.

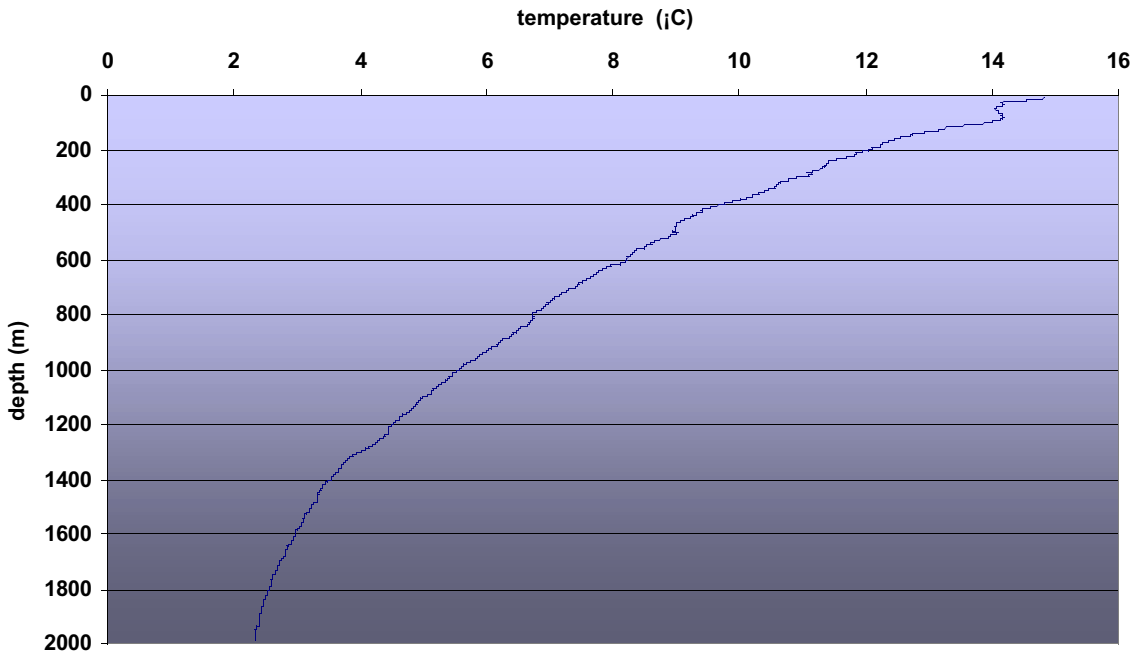

Fig. 10.9.: Temperature profile on the southern Hikurangi plateau.

Salinity

Salinity ranges between 35.16‰ at the water surface and 34.45‰ at 800 m depth (Fig. 10.10.). Due to dilution of the surface water by precipitation, highest values of 35.25‰ are detected at 80 m depth. Immediately below this depth there is a sharp salinity decrease to 35.1‰, documenting a first halocline that coincides with the thermocline. The overall salinity decrease characterizing the SAMW is interrupted by two minor haloclines in the deepest part of this water mass at 550 and 610 m depth, the latter characterizing the SAMW/AAIW boundary.

Conspicuously, these depths coincide with the occurrence of living reefs on the southern slope of Chatham Rise. The profile through the underlying AAIW first shows a slight salinity decrease to the minimum of 34.45‰ at 800 m, corresponding with the position of the AAIW core south of Chatham Rise (Nelson et al. 1993) and with the salinity data provided by Fenner et al. (1992) for the southern Hikurangi plateau. This trend shifts to slightly increasing values below 1,200 m depth towards the base of the profile, documenting a density rise in the deeper part of the AAIW.

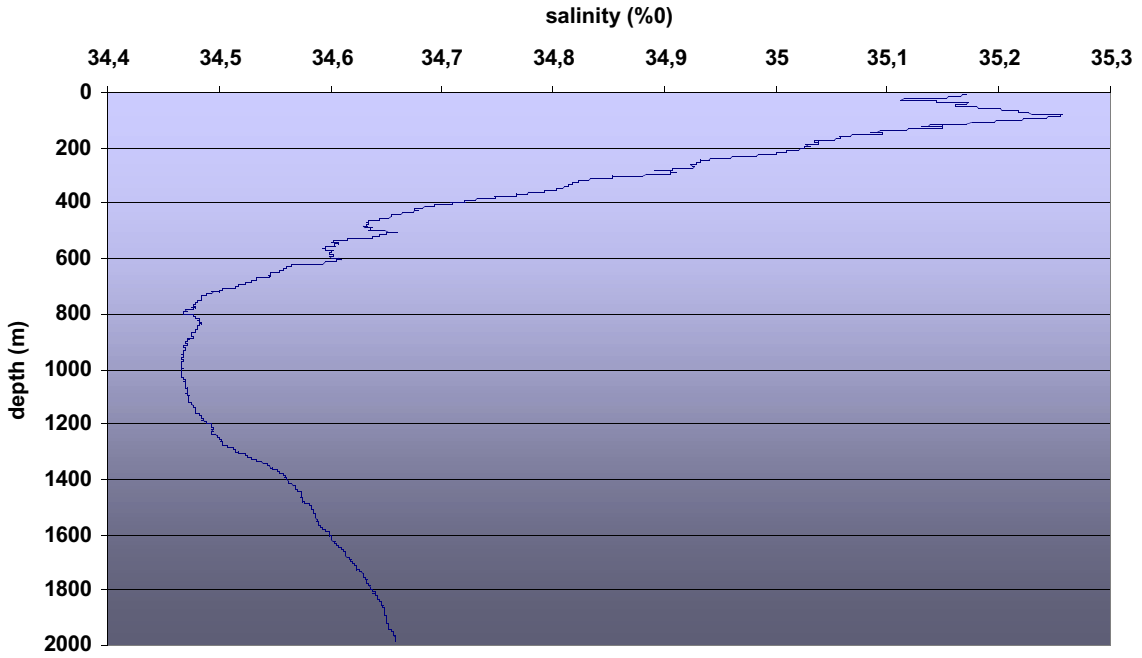

Fig. 10.10.: Salinity profile on the southern Hikurangi plateau.

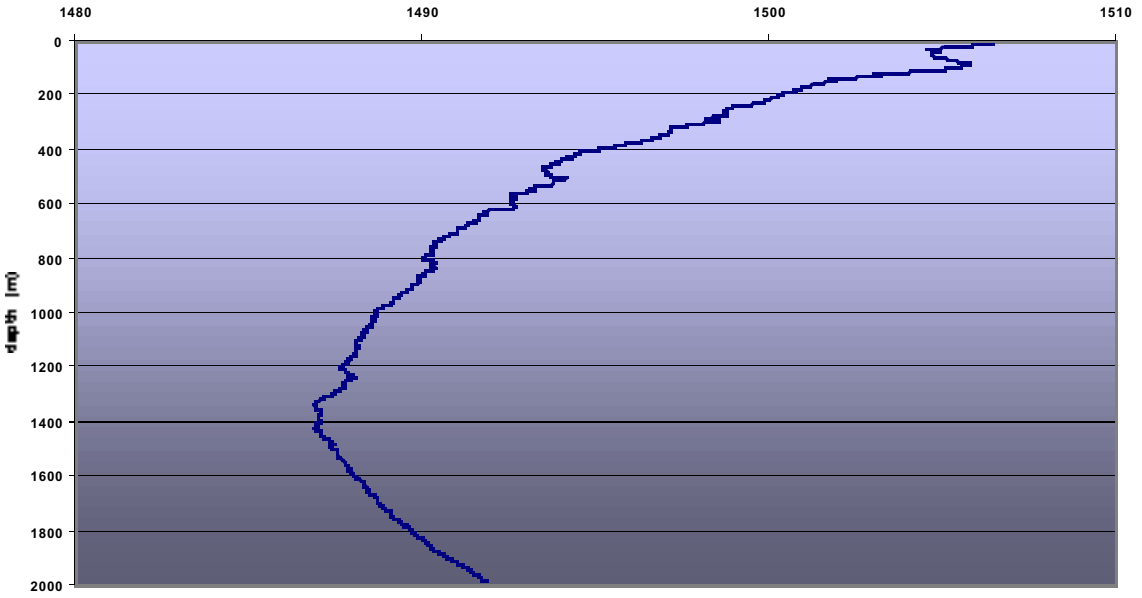

Fig. 10.11.: Sound velocity profile on the southern Hikurangi plateau.

Sound Velocity

The sound velocity profile as a whole correlates well with the measured salinity profile in that it reveals an overall continuous decrease from 100 m down to 1,400 m depth, followed by an increase within the AAIW. Fluctuations in the surface water are caused by strong warming in the early summer season.

Oxygen

Oxygen saturation of surface and intermediate water masses is characterized by an overall decrease down to 1,700 m depth: O_2 amounts continuously decrease within the surface water from 10.06 mg/l at the water surface to 9.3 mg/l at 60 m depth (Fig. 10.12.). The uppermost 300 m of the underlying SAMW reflect a continuous O_2 decrease to 8.7 mg/l due to the lack of photosynthetic phytoplankton. Lower part of the SAMW comprising the depths of active coral / stylasterid growth along the southeastern Chatham Rise margin reveals several fluctuations within the 8.5 to 8.9 mg/l range, ending with a dramatic decrease to 8.1 mg/l at the base of SAMW. Lowest oxygen amounts of the cast (6.5 mg/) are found in the AAIW due to the stable thermohaline stratification and oxygen consumption through decomposition of sinking organic matter in the overlying water masses. Beneath 1,800 m depth, O_2 saturation slightly increases due to bottom water mixing by contour currents moving along the northeastern margin of the Hikurangi Plateau.

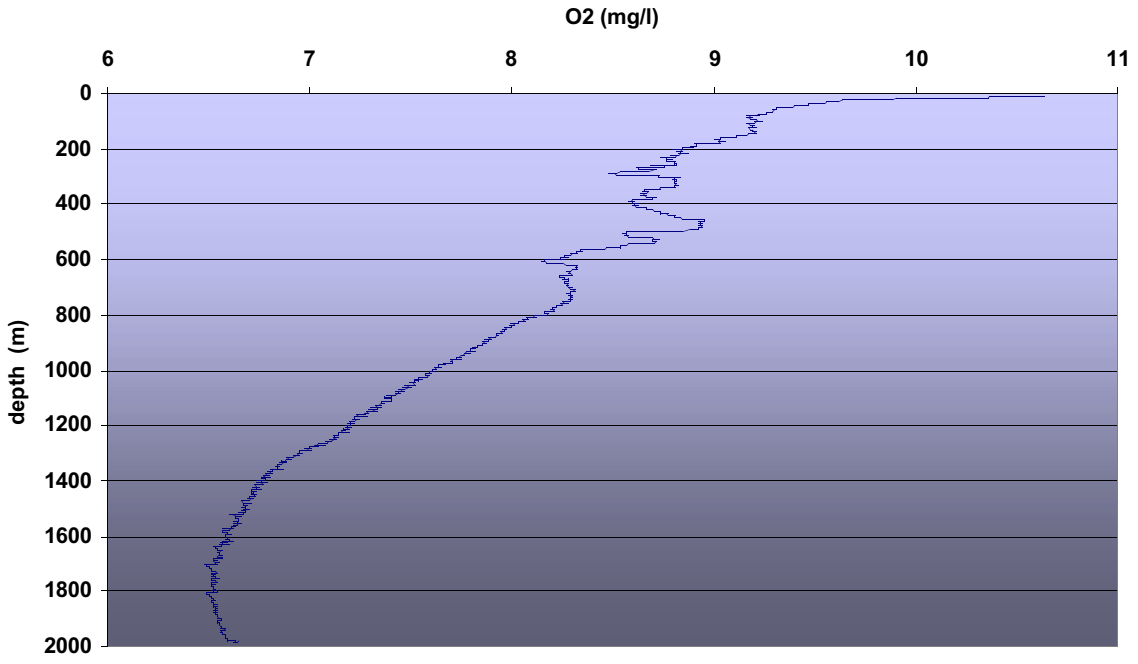

Fig. 10.12.: Oxygen saturation profile on the southern Hikurangi plateau.

10.5. CONCLUSIONS TO MODERN CNIDARIAN REEFS ON SOUTHERN CHATHAM RISE

Discoveries of modern deep-water scleractinian corals and stylasterids obtained on SO 168 cruise match well with the general pattern reported by Cairns (1991, 1995): Colonial (*Goniocorella*) and solitary (*Flabellum, Desmophyllum*) scleractinian corals dominate along the southeastern slope of Chatham Rise south of Chatham Islands as well as on the southern slopes of Matheson and Veryan banks further to the east, whereas stylasterids and gorgonians are concentrated south of Chatham Islands and on the southwestern margin of Chatham Rise (Urry Knolls region).

This distribution elucidates a concentration of modern reef-forming cnidaria along the southeastern and southwestern slope of Chatham Rise, furthermore around the southern slopes of isolated volcanic banks on the Rise crest. Assuming that temperature and salinity conditions of the water masses and depths of their boundaries are similar to those on the southern Hikurangi Plateau (see 10.4.3), it may be concluded that these metazoans are tied to the Subantarctic Mode Water which provides ideal growth conditions due to its well-mixed and fixed thermostads with uniform temperature and salinity. In the deepest part of SAMW, topographically focused boundary currents at two haloclines concentrate particulate organic matter and sinking plankton which is largely spared decomposition due to the considerable O_2 depletion at that level, thus providing the essential nutrients to the heterotrophic deep-water cnidaria at the SAMW / AAIW boundary.

Other possible oceanic controls responsible for high hydrodynamic energy are: 1. strong cyclonic circulation flow around the western edge of Bounty Trough and southwestern margin of Chatham Rise; 2. current-induced upwelling of the nutrient-rich AAIW on the southwesternmost Chatham Rise and Mernoo Saddle (Weaver et al. 1998), triggering a high phyto- and zooplankton productivity that will foster aphotic coral growth by benthic-pelagic coupling.

Conclusions: These preliminary results provide evidence of oceanographic controls on deep-water cnidarian reef growth in the Chatham Rise area. These are: cool-temperate waters, homotherme and homohaline water masses, lowered oxygen conditions, and high hydrodynamic energy responsible for nutrient supply to the reef sites and for preventation of fine-grained sediment accumulation on the corals and on their hard colonization substrata. Cold seep structures such as pockmarks reported from some slope failures along the southeastern margin of New Zealand were not discovered during the cruise, but may not be excluded. Identification of bacterial consortia in the recovered sediments and stable isotope analysis on calcareous skeletons

and some carbonate cements will elucidate a possible endogenic control of reef growth by focused hydrocarbon seepage or decomposing methane hydrates.

10.6. FOSSIL CORAL OCCURRENCES ON SOUTHERN HIKURANGI PLATEAU

Fossil, manganese-encrusted deep water corals were obtained from the Graveyard, Moore and Polar Bear seamounts on the northern Chatham Rise margin and southern Hikurangi Plateau at water depths between 2,400 m to 870 m. The coral community structure is composed of scleractinian *Madrepora* colonies occurring as non-symbiotic *Madrepora* forma *vitiae* (Cairns 1995) and in symbiotic association with commensal polychaetes worms that form tube galls throughout the corallum (Figs. 10.13a, b, 10.14.). Stylasterids are associated locally, but are generally rare.

Due to the manganese encrustations of up to 1 mm thickness, the corals are probably of Pleistocene age (last glacial maximum and older). The oldest azooxanthellate scleractinian buildup formed by *Lophelia parvisepta* is described from Late Miocene mudstones near Hinakura, North Island of New Zealand (Squires 1964). Latest Miocene characterizes the entering of Subantarctic Mode Water, responsible for organic particle flux to the depths of today´s coral growth. This may have triggered the onset of azooxanthellate coral reef evolution on subsiding carbonate platforms that had developed during the Neogene north and south of the New Zealand islands in temperate climate zones (Wood et al. 1989).

Fig. 10.13a, b: Fossil colonies of Madrepora with polychaete tube worm symbiont, encrusted by manganese / iron oxides. Moore Seamount, southern Hikurangi Plateau. Width of top image is 10 cm, of obove image measures 15 cm.

Fig. 10.14.: Fossil manganese-encrusted symbiotic form of Madrepora: association wth commensal polychaetes forming tube galls throughout the corallum, and non-symbiotic Madrepora forms vitiae (arrow). Graveyard Seamounts, southern Hikurangi plateau. Width of image measures 15 cm.

Future Research on Fossil Corals

Absolute age dating of the newly discovered manganese-encrusted fossil corals will be carried out by means of radiogenic U/Th and ^{14}C isotope analysis. In addition, stable oxygen and carbon isotopes will be measured on the fossil coral skeletons. Ultimate aim is to reconstruct the migration of oceanic frontal systems and the changes of contour current circulation patterns, upwelling currents and nutrient levels and the thereby triggered productivity changes during Pleistocene glacial-interglacial cycles. This will help to unravel the oceanographic and climatic history of the Chatham Rise and the deep water reef evolution through Quaternary time.

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APPENDICES:

I. Sampling Summary

II. Petrographic Summary

III. Rock Description (dredge station locations and rock sample descriptions)

IV. Soft Sediment Descriptions

V. Biological Sampling (station locations and biological sample descriptions)

Appendix I (Sampling Summary)

SO168 SAMPLING SUMMARY

Sites: 105 stations, 95 dredges, 6 TVG grabs, 4 box corers

Recovery: 77 stations hard rock, 48 Mn crusts, 62 sediments, 73 biological

Type	Station	Name	Wt dredge	Rock summary	Midpoint lat	Midpoint long	Min	Max	Rock	Mn	Sed	Bio
			kg		dec deg	dec deg	depth m	depth m				
DR	1	Mt Spong A	2	Soft volcanic breccia and sandstone	-39,8135	167,2359	972	1076	1	0	0	0
DR	2	Mt Spong B	5	Two pieces of fsp + ?nepheline-porphyritic lava	-39,8085	167,2383	957	1055	1	0	0	1
DR	3	Graveyard A	250	Vesic/amygd olivine micropptic basalt. Some pillow/tube forms. Possibly all from single flow	-42,7515	-179,9860	976	1018	1	1	0	1
DR	4	Graveyard B	10	3 rocks only: basaltic breccias, highly altered and Mn cemented	-42,7594	-179,9894	773	807	1	1	0	1
DR	5	Morgue	700	Vesic/amygd olivine pptic basalts and brown volcanic breccia. One silicified ?bone or?wood piece	-42,7127	-179,9519	1025	1185	1	0	1	1
DR	6	Headstone	3	A few volcaniclastic breccias	-42,6674	-179,9530			1	0	1	1
DR	7	Shipley A	0.5	One piece each of volcanic breccia, ol px basalt	-41,8282	-179,4725			1	0	1	0
DR	8	Shipley B	0	No rocks	-41,7953	-179,4608			0	0	1	0
DR	9	Shipley C	500	95% Mn crusts; suite of cpx + ol pptic and aphyric basalts, volcanic breccias, phosphorite nodules	-41,8455	-179,5281	1534	1732	1	1	1	1
DR	10	Shipley D	0	No rocks	-41,8034	-179,4828			0	0	0	0
DR	11	Bolger	5	Mn crusts only	-41,1178	-179,7566			0	1	1	1
DR	12	Moore A	50	Jointed aphyric basalt (flow top?) pieces, several Mn crusts, one pumice, one breccia	-40,4169	-179,4364	2078	2312	1	1	1	1
DR	13	Moore B	300	90% Mn crusts but some scoriaceous ol pptic basalt, palagonitic breccia and calcareous sedimentary rocks	-40,4219	-179,4503	1605	1865	1	1	1	1
DR	14	Moore C	0	No rocks	-40,5546	-179,5021			0	0	1	0
DR	15	Moore D	50	Mn nodules and thick crusts, only a couple with corroded sandstone nuclei	-40,4458	-179,4578	1651	1932	1	1	0	1
TVG	16	Plateau nr Moore	0	No rocks	-40,3452	-179,3936			0	0	1	1
KG	17	Plateau nr Moore	0	No rocks	-40,3450	-179,3946			0	0	0	0
DR	18	Rowling A	50	Mainly volcanic breccias, some vesicular ol pptic lavas, 2 separate Mn-crusts	-39,6381	179,3202	2500	2753	1	1	1	0
DR	19	Rowling A	2	Mn crusted palagonitic breccias, one highly vesicular plag basalt clast with some fresh glass	-39,5587	179,2259	2512	2660	1	1	0	1
DR	20	Kirk A	0	Empty dredge	-39,4490	179,8531			0	0	1	0
DR	21	Kirk B	30	Mn crusted non-vesicular olivine basalts, some volcanic breccia	-39,4836	179,8864	2378	2886	1	1	1	1
DR	22	Kirk C	15	Yellow and grey volcanic breccias, Mn crusted. Some cc amygd olivine basalts as breccia clasts.	-39,5363	179,9118	2918	3045	1	1	1	1
DR	23	Palmer A	300	Single subrounded Mn boulder with phosphatic and corroded volcanic breccia cores	-39,5390	-178,5086	2974	3183	1	1	0	1
DR	24	Palmer B	0	Empty dredge	-39,5218	-178,5808			0	0	1	0
DR	25	Palmer C	20	Mostly Mn encrusted breccia, some amygdaloidal olivine basalts	-39,5294	-178,4969	2881	3134	1	1	1	0
DR	26	Lange A	10	Brown vesicular aphyric lavas and brown-yellow Mn crusted breccias	-39,1019	-177,5058	3285	3509	1	1	0	1
DR	27	Lange B	15	Mn crusts up to 10cm thick with corroded cores of volcanic or volcaniclastic material	-39,0521	-177,4676	2338	2644	0	1	0	1
DR	28	Lange C	0	No rocks	-39,0355	-177,2686			0	0	1	0
DR	29	Katz	200	Two thirds fresh olivine (altd) and plag (fresh)-phyric basalts; one third volcanic breccias	-38,7732	-176,9593	2828	3116	1	1	1	1
DR	30	Muldoon	0.1	Single small piece of vesicular olivine basalt, fairly fresh	-38,5054	-176,5843	3341	3634	1	0	1	0
DR	31	Marshall	0	No rocks	-38,0344	-177,4848			0	0	0	1
DR	32	Kiwi Ridge A	15	Yellow-brown hyaloclastite and volcanic breccias; some grey zeol-amygd olivine basalts; mudstone; Mn-rinds	-36,3129	-178,8262	4133	4443	1	1	1	1
DR	33	Kiwi Ridge B	30	Vesicular-amygdaloidal olivine basalts. Zeolite & calcite alteration.	-36,2820	-178,8218	4139	4470	1	1	1	1
DR	34	Rapuhia A	1300	95% volcanic breccias and sandstones. 5% of dredge is cpx-plag basalt, dolerite & gabbro.	-35,9960	-178,5256	5399	6182	1	0	1	1
DR	35	Moa	450	Hydrothermally altered aphyric lavas. Many, but small, fresh kernels.	-36,0292	-178,2814	5167	5918	1	1	1	1
DR	36	Rapuhia B	25	Weathered lava, dolerite and gabbro; also sedimentary rocks	-36,0409	-178,4734	5478	6001	1	0	0	1

Appendix I (Sampling Summary)

Type	Station	Name	Wt dredge kg	Rock summary	Midpoint lat dec deg	Midpoint long dec deg	Min depth m	Max depth m	Rock	Mn	Sed	Bio
DR	37	Rapuhia C	5	Sedimentary rocks: mainly sandstones, breccias	-36,1205	-178,3915			1	1	0	0
DR	38	Rapuhia D	70	Dominated by volcaniclastic rocks, subordinate basalt & dolerite	-36,3805	-178,1334	5028	5609	1	1	1	0
DR	39	Rapuhia E	400	95% grey-brown basalts, variably clay altered. One big boulder palagonite breccia, poss with fresh glass	-36,3885	-178,1154	5017	5578	1	1	0	1
DR	40	Tuatara	5	Only mod hard basalt-dolerite with chlorite-actinolite alteration	-36,4702	-177,7168	4728	5076	1	0	0	0
DR	41	Savage A	200	One large boulder Mn crust	-36,6351	-177,7973			0	1	0	1
DR	42	Savage B	20	Mainly Mn crusts with some sedimentary (and small highly altered lapilli) cores	-36,6779	-177,7736	3407	3845	1	1	0	1
DR	43	Kiore	30	Mainly black-brown aphyric vesic basalt, one small palag breccia, some detached Mn rinds	-36,6527	-177,2102	4184	4718	1	1	1	0
DR	44	Rapuhia F	30	Mainly sedimentary rocks (sandstones, breccias) and Mn rinds, a few small pieces of pumice	-37,1293	-177,1357	4280	4796	1	1	0	1
DR	45	Rapuhia G	20	Sedimentary rocks (sandstones, breccias) and Mn crusts	-37,1549	-176,7326	4310	5039	1	1	0	0
DR	46	Penguin A	5	Three Mn crusts	-40,6621	-173,7817	2673	2999	1	1	1	1
DR	47	Penguin B	30	Volcanic breccias with partly fresh vesicular olivine basalt clasts. Lots of Mn crusts.	-40,6288	-173,7579	2757	3134	1	1	1	1
DR	48	Polar Bear A	0	No rocks	-41,5162	-173,9588	2082	2504	0	0	1	0
DR	49	Polar Bear B	200	Fresh ol, px, plag & FeTiox pptic basalts, some slightly amygd, one limestone, two congloms	-41,4640	-174,1902	2072	2710	1	1	1	1
DR	50	Polar Bear C	4	10 rocks, sparsely olivine, cpx pptic basalts. One piece possible fresh glass rind, one piece of blue-grey clay	-41,4239	-174,1854	2135	2438	1	1	1	0
TVG	51	Polar Bear top A	0	No rocks. Pillow lavas and Mn nodules seen on TV	-41,4373	-174,1175	1840	1849	0	0	1	1
TVG	52	Polar Bear top B	0	No rocks	-41,4791	-174,1666	1957	1959	0	0	1	1
KG	53	Polar Bear top C	0	No rocks	-41,4862	-174,1663	1957	1957	0	0	1	0
DR	54	Wishbone A	12	Coarse-fine grained sst & siltst, some as Mn-cemented breccia clasts, some as individual Mn-coated pieces	-40,6373	-169,7442	3030	3750	1	1	0	1
DR	55	Wishbone B	20	One large sandstone boulder, some feldspar rich volcanic rocks (dacitic?)	-40,7508	-169,8312	2567	3300	1	1	0	1
DR	56	Wishbone C	50	Grey and red feldspar porphyritic dacitic lavas and ?shallow intrusives, some catalcastic	-40,7607	-169,8438	2752	3548	1	1	1	0
DR	57	Hünchen	100	Mainly highly altered aphyric ?basalts or hawaiites, some fresher plag porphyritic ?dacites, volcanic breccias	-41,0577	-169,0940	2350	2796	1	1	1	1
DR	58	Pukeko	500	Subangular boulders of platy, aphyric ?trachytic lava, most are vesicular, few are dense, fairly fresh	-41,7319	-169,2848	3127	3710	1	1	1	1
DR	59	Weta A	10	Three boulders of grey-brown vesicular olivine basalt, one piece with thick Mn crust	-42,2808	-168,8505	2436	2907	1	1	0	0
DR	60	Weta B	7	One boulder of very Mn-altered, Mn-crusted volcanic breccia	-42,2602	-168,8790	2570	2855	1	1	0	0
DR	61	Kakapo A	0.5	Two small Mn nodules, one with 3mm lava fragments in core	-168,6125	-43,4727	2755	3174	1	1	1	1
DR	62	Takahe	1000	Half dozen blocks up to 1.5m, Mn-crusted volcanic-hypabyssal dacitic-granitic rocks, some cataclastic	-168,7539	-43,0619	2441	3102	1	1	0	1
DR	63	Kakapo B	10	Volcanic breccia with brownish plag-phyric basalt clasts, Mn-crust	-168,5473	-43,4923	2830	3221	1	1	1	1
DR	64	Kiel	0	No rocks	-168,2228	-43,6816			0	0	1	0
DR	65	Hamburg	30	Single Mn block with small amygdaloidal lava & phosphorite nodule corestones	-170,0408	-44,5238	3271	3798	1	1	0	1
DR	66	Erik	2	A few sparsely plag-phyric basalt pieces (one very fresh) + 1 phosphorite nodule	-172,0952	-44,757	2534	2954	1	0	1	1
DR	67	Frankfurt	50	Two types of lava: aphyric, highly vesicular; and porphyritic with less vesicles	-172,5988	-45,6912	3560	4030	1	1	1	1
TVG	68	Stuttgart	0	Full of sediment, no rocks	-173,3791	-45,4882			0	0	1	1
KG	69	Stuttgart	0	No material, corer did not open properly	-173,3787	-45,4884			0	0	0	0
DR	70	Stuttgart	0	No rocks	-173,2396	-45,4856			0	0	0	0
DR	71	Stuttgart	20	Greenish greyschist, different metamorphic grades.	-173,2612	-45,4887	3654	4240	1	1	0	0
DR	72	München	1000	Mainly sorted volcanic breccias, a few vesic plag pptic lavas as bombs & clasts, Mn-crusts, phosphate nodules	-174,0533	-44,7154	1979	2286	1	1	1	1
DR	73	Western Uprising	400	Mainly hard, phosphorite beds and nodules, some volcanic breccias, a few basalts, one poss a dropstone	-174,4759	-44,2175	874	965	1	1	0	1
DR	74	Chapmans Hill	150	Mostly coral fragments. A few hard, relatively fresh cc amygd ol basalt cobbles	-174,5489	-44,154	610	871	1	0	0	1
DR	75	Unlucky Hill	0	No rocks	-174,9706	-44,3638	708	742	0	0	0	0
DR	76	Howson A	80	99% modern bivalve & brachiopod shells, some live. One pebble altered volcanic breccia	-175,303	-43,9361	98	134	1	0	0	1

Appendix I (Sampling Summary)

Type	Station	Name	Wt dredge	Rock summary	Midpoint lat	Midpoint long	Min	Max	Rock	Mn	Sed	Bio
			kg		dec deg	dec deg	depth m	depth m				
DR	77	Howson B	0.5	Half dozen mussel shells and one piece brown-orange volcanic breccia	-175,2941	-43,9394	120	130	1	0	0	0
DR	78	Howson C	15	Mainly cemented broken shell debris. Two small pieces volcanic breccia.	-175,2884	-43,9446	104	127	1	0	0	1
DR	79	Howson D	100	Mostly biological material. 1kg basalt pieces & breccia.	-175,3146	-43,9538	103	112	1	0	0	1
DR	80	Charlton A	250	90% biological material. 10% basalts, ol + ol-cpx-phyric, some with megacrysts and ultramafic xenoliths	-175,4653	-44,1947	161	253	1	0	0	1
DR	81	Charlton B	400	Mainly one large boulder of brown calcite-cemented basaltic breccia. Half a dozen small rocks and a few shells	-175,4516	-44,2303	101	124	1	0	1	1
DR	82	Hicks	5	Altered calcite-amygdaloidal olivine-phyric basalts	-175,3521	-44,4621	386	515	1	0	0	1
DR	83	FBI	500	Mainly volcanic breccia; a few pieces of olivine basalt. 1-2kg biological samples.	-175,2126	-44,6779	755	1024	1	1	1	1
DR	84	Gore	600	Mostly phosphorite. 10% amygd alt ol basalts, some red volc breccias. 5% high grade met & plut dropstones.	-175,7524	-44,6088	884	1192	1	0	1	1
DR	85	Monkhouse	4	Half corals & bryozoa. Half fresh grey basalts with alt olivine phenos and calcite amygdules	-176,292	-44,6639	740	793	1	0	1	1
DR	86	Jones	250	99% fragments of broken, living coral mound. Five small pieces of altered olivine-phyric basalt	-176,522	-44,5968	421	563	1	0	1	1
DR	87	Perry	15	One third biological samples, two thirds fresh ol+cpx+-plag porphyritic basalts. Three dropstones	-176,8218	-44,6414	511	684	1	0	1	1
DR	88	Thompson	400	Mainly altered volc breccia & basalts, a few fresher basalts & dropstones. Small amount of biological material	-176,7985	-44,735	733	988	1	0	1	1
DR	89	Clerke A	150	Mainly as one bio-encrusted volc breccia boulder. A few pieces mostly breccias, one basalt, 1 PO4-nodule	-177,1241	-43,8725	84	127	1	0	0	1
DR	90	Clerke B	0	Cable broke, dredge was lost	-177,1257	-43,881	148	156	0	0	0	0
DR	91	Manley	80	Mainly red- orange volcanic breccias. Some grey breccias with very small, fresh basalt clasts.	-177,3736	-43,3676	189	204	1	0	0	1
TVG	92	Haystack A	0	No rocks	-178,6509	-43,0611	526	528	0	0	1	1
KG	93	Haystack B	0	No rocks	-178,651	-43,0613	527	527	0	0	1	1
DR	94	Matheson A	0	No rocks	-179,2167	-44,0048	268	285	0	0	1	0
DR	95	Matheson B	0	No rocks	-179,2476	-43,9973	252	272	0	0	0	1
DR	96	Silke Vulkan	400	Grey-dark brown cc-amygdaloidal olivine-cpx basalt. Minor breccia, limestone.	176,4523	-44,0527	405	605	1	0	1	1
DR	97	Orton	30	1/3 ol-px and ol-px-hb-phyric basalts, some quite fresh. 2/3 volcanic breccias with clasts of these lavas	176,188	-44,3514	400	575	1	0	0	1
DR	98	Gathrey	350	Fresh olivine-phyric, calcite-amygdaloidal basalts, a few breccias.	175,9193	-44,4026	420	490	1	1	1	1
DR	99	Anja Vulkan	450	Hard, brownish grey olivine-phyric calcite-amygd basalt. Some volcanic breccia with limestone matrix	175,8501	-44,5083	644	731	1	0	1	1
DR	100	Young Nick	0	No rocks	174,9393	-44,8155			0	0	1	0
DR	101	Jordan	1	Two rocks: rounded cobble fresh grey ol-phyric vesicular basalt and dark brown volcanic breccia	174,8784	-44,7585	610	853	1	0	1	1
DR	102	Reading	0.1	One piece coral and one small broken piece brown zeol-amygd olivine-phyric basalt	174,8505	-44,7582	631	821	1	0	1	1
TVG	103	Urry Plain	0	No rocks	174,8177	-44,7535			0	0	1	1
DR	104	Forwood	1200	1/8 corals, 1/4 fresh black ol-phyric vesic basalts, 5/8 red-brown volc breccias, grading to rare sandy limestones	174,3984	-44,7678	594	770	1	0	1	1
DR	105	Bootie	1000	Mainly fresh vesicular ol+cpx-phyric lavas (some cc in amygdules)	174,2464	-44,6036	597	719	1	0	1	1
			14997									

Appendix II (Petrographic Summary)

Petrographic Summary															
							ROCK TYPE								
phenocrysts		O	OC	C	OP	OCP	[OCP]	OCH	aphyric	P	P±K			fresh	datable?
rocks		bas	bas	bas	bas	bas	bas dol gab	bas/int	bas/int	bas/int	dac-grnt	schist		separable	material
notes		usu ves					equigran							minerals	
CHALLENGER PLATEAU															
Mt Spong	DR2									**Y**				P	wr, P
(no lavas from Mt Spong DR1)															
HIKURANGI PLATEAU															
Interior Guyots															
Shipley	DR7, 9		Y						**Y**					C	wr
Moore	DR12, 13	Y							Y					-	wr
Rowling	DR18, 19	Y								Y				glass	wr, P
Kirk	DR21, 22	**Y**												-	wr
Palmer	DR25	Y												-	wr
Lange	DR26								Y					-	wr
Katz	DR29				**Y**									P	wr, P
Muldoon	DR30	**Y**												-	wr
Polar Bear	DR49, 50	**Y**	**Y**		Y	**Y**			Y					C, P, Ilm	wr, P
(no rocks in Shipley DR8, 10; Bolger 11, Moore 14, 16-17, Kirk 20, Palmer 24, Polar Bear 48)															
(nothing analysable in Moore 15, Palmer 23)															
Marginal Ridges															
Kiwi	DR32, 33	Y												glass	wr
Savage	DR42	!												glass?	-
Penguin	DR47	Y												-	wr
(no rocks from Marshall 31, Penguin 46)															
Rapuhia Scarp	DR34, 36, 38-39				Y		Y							glass, P	wr, P
(only sedimentary rocks in Rapuhia 37, 44, 45)															

Appendix II (Petrographic Summary)

							ROCK TYPE								
phenocrysts		O	OC	C	OP	OCP	[OCP]	OCH	aphyric	P	P±K			fresh	datable?
rocks		bas	bas	bas	bas	bas	bas dol gab	bas/int	bas/int	bas/int	dac-grnt	schist		separable	material
notes		usu ves					equigran							minerals	
SMALL PACIFIC SEAMOUNTS															
Moa	DR35								**Y**					?	wr
Tuatara	DR40						Y							P	P
Kiore	DR43								**Y**					glass	wr
(all successfully sampled)															
EASTERN ZEALANDIA															
Wishbone	DR55, 56										**Y**			P±K	P±K, Zc
Hünchen	DR57								Y	Y				P	wr, P
Pukeko	DR58								Y					-	wr
Weta	DR59	Y													
Takahe	DR62										Y			P±K	P±K, wr, Zc
Kakapo	DR63									!				P	P
(only sedimentary rocks in Wishbone 54; nothing analysable in Weta 60, Kakapo 61; no rocks in Kiel 64)															
LARGE SEAMOUNTS SOUTH OF CHATHAM RISE															
Hamburg	DR64				!									P	P
Erik	DR65									Y				P	P
Frankfurt	DR67								Y	Y				glass, P	P
Stuttgart	DR71											Y			wr, Mica
München	DR72									Y				P	P
(no rocks in Stuttgart 68-70)															

Appendix II (Petrographic Summary)

							ROCK TYPE								
phenocrysts		O	OC	C	OP	OCP	[OCP]	OCH	aphyric	P	P±K			fresh	datable?
rocks		bas	bas	bas	bas	bas	bas dol gab	bas/int	bas/int	bas/int	dac-grnt	schist		separable	material
notes		usu ves					equigran							minerals	
CHATHAM ISLANDS AREA															
West Uprising-Chapmans Hill	DR73, 74	Y				Y						Y		O, C, P	P
Howson	DR76, 79	Y							Y					-	wr
Charlton	DR80, 81	Y	Y											C, O	wr
Hicks	DR82	!												-	-
FBI	DR83	Y												-	wr
Gore	DR84	!												-	-
Monkhouse	DR85	**Y**												?	wr
Jones	DR86	!												-	-
Perry	DR87		**Y**			**Y**								C, P	wr, P
Thompson	DR88	Y												-	-
Clerke	DR89	Y		Y										C	wr
Manley	DR91			Y										C	wr
(no rocks from Unlucky 75, Clerke 90; nothing analysable in Howson 77-78)															
WESTERN CHATHAM RISE															
Graveyard	DR3	Y												-	wr
Morgue	DR5	**Y**												-	wr
Headstone	DR6													glass?	-
Silke Vulkan	DR96		**Y**											C	wr
Orton	DR97		**Y**					**Y**						C, H	wr
Gathrey	DR98	Y												-	wr
Anja Vulkan	DR99	Y												-	-
Jordan	DR101	**Y**												-	wr
Reading	DR102	Y												-	-
Forwood	DR104	**Y**	**Y**											C	wr
Bootie	DR105	**Y**	**Y**											C	wr
(no rocks from Young Nick 100, Urry Plain 103; nothing analysable in Graveyard 4)															

Appendix II (Petrographic Summary)

							ROCK TYPE								
phenocrysts		O	OC	C	OP	OCP	[OCP]	OCH	aphyric	P	P±K			fresh	datable?
rocks		bas	bas	bas	bas	bas	bas dol gab	bas/int	bas/int	bas/int	dac-grnt	schist		separable	material
notes		usu ves					equigran							minerals	
Footnotes:															
O=olivine, C=clinopyroxene, P=plagioclase, H=hornblende, K=K-feldspar, Ilm=ilmenite-magnetite, Zc=zircon, wr=whole rock															
usu ves=usually vesicular, int=intermediate lava composition, dac-grnt=dacite-granite, [ ]=no phenocrysts but minerals present															
Y	fresh grey gmass and/or glass. Vesicles not amygdules														
Y	hard brown rock, but altered gmass and/or some amygdules														
!	soft rock, highly altered, small and/or amygdaloidal														

SO168 ROCK SAMPLING DESCRIPTIONS

STATION 1. MOUNT SPONG A
SW inner wall of crater
Dredge on bottom UTC 14/12/02 1050hrs, lat 39º48.814'S, long 167º14.291'E, depth 1076m
Dredge off bottom UTC 14/12/02 1120hrs, lat 39º48.803'S, long 167º14.013'E, depth 972m
2kg. Soft volcanic breccia and sandstone

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR1-1	subrounded 12x12x4cm slab broken into 3 pieces	brown, fg sandstone, prob volcaniclastic. Mn rind <1mm					Y	Y		
DR1-2	rounded 11x6x5cm	soft polymict fg volcanic breccia. No Mn rind					Y	Y		grey, red, buff vesicular clasts

STATION 2. MOUNT SPONG B
W inner wall of crater
Dredge on bottom UTC 14/12/02 1237hrs, lat 39º48.502'S, long 167º14.397'E, depth 1055m
Dredge off bottom UTC 14/12/02 1304hrs, lat 39º48.523'S, long 167º14.196'E, depth 957m
5kg. Two pieces of fsp and ?nepheline-porphyritic lava

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR2-1	subangular 40x20x15cm slab w one broken face	fresh, greyish green lava, 5-7% phenos of fsp and/or ?nepheline	Y	Y	Y	plag neph		Y		
DR2-2	irreg bored 20x20x10cm piece	fresh, grey-yellow-green lava 7-10% phenos mainly fsp, >>1% cpx	Y	Y	Y	px plag		Y		weathering rind up to 10mm

STATION 3. GRAVEYARD A
NE flank
Dredge on bottom UTC 16/12/02 2048hrs, lat 42º45.088'S, long 179º59.092'W, depth 1018m
Dredge off bottom UTC 16/12/02 2118hrs, lat 42º45.094'S, long 179º59.229'W, depth 976m
250kg, dredge 1/3 full. Amygd olivine microptic basalt. Some pillow/tube forms. Whole dredge is possibly from a single flow

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR3-1	15x10x15cm subrounded	brown to grey (inside) microporphyritic (5-10%) olivine basalt; 20% amygdules, partly filled	Y	Y	Y					freshest sample. Mn rind <2mm; amygdules 2-5mm with white siliceous or phosphatic material
DR3-2	10x10x10cm subrounded	similar to DR3-1; microporphyritic olivine basalt	Y	Y	Y					
DR3-3	25x15x15 cm subrounded	similar to DR3-1	Y	Y	Y			Y		white material on joint; vesicles 2-3 mm
DR3-4	10x10x15 cm subrounded	similar to DR 3-3						Y		
DR3-5	10x10x15 cm subrounded	similar to DR 3-4								
DR3-6X	10x10x15 cm subrounded	similar to DR 3-5					Y			vesicle 1-2 mm- smallest size of vesicles
DR3-7X	20x15x10 cm subrounded	similar to DR3-6X but more amygdules are filled with white siliceous/phosphatic material					Y			Mn rind < 1mm
DR3-8X	20x15x10 cm subrounded	similar to 7X but has still more amygdule fillings. More brownish than grey					Y			
DR3-9X	20x15x10 cm subrounded	similar to 7X in size and description, but sample sawn to retain just the vesicular part; amygdule-rich part discarded					Y			1 cm Mn crust-thickest of the dredge
DR3-10X	subrounded 10x10x4 cm	1mm Mn-crusted brown lava					Y			not sawn
DR3-11X	subrounded 10x10x4 cm	same as DR3-10X					Y			not sawn
DR3-12X	subrounded 10x12x7 cm	same as DR3-10X					Y			not sawn
DR3-13X	subrounded 10x12x7 cm	same as DR3-10X					Y			
DR3-14X	large unsawn sample 40x30x30 cm	possible lava tube					Y			amygdules inside + vesicles in exterior
DR3-15X	large sample. 40x40x30 cm; rounded boulder	grey brown lava					Y			large vesicles; not sawn
DR3-16X	large broken boulder, 30x30x30 cm	grey brown lava with large vesicles					Y			not sawn
DR3-17	12x12x15 cm rounded piece	brownish, hard, vesicular + amygdaloidal lava, cut by calcareous vein						Y		some amygdules calcareous too

STATION 4. GRAVEYARD B
Top
Dredge on bottom UTC 16/12/02 2237hrs, lat 42º45.48'S, long 179º59.36'W, depth 807m
Dredge off bottom UTC 16/12/02 2259hrs, lat 42º45.650'S, long 179º59.365'W, depth 773m
10kg. 3 rocks only. Basaltic breccias, highly altered and Mn cemented

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR4-1X	30x30x10 slab	brown volcanic breccia, strongly cemented + altered with Mn and ?phosphatic material					Y	Y		
DR4-2X	30x20x8 cm slab	similar to DR 4-1 X; some matrix is limestone					Y			
DR4-3X	20x15x6cm	similar to DR 4-1 X but has the most Mn cement					Y			

STATION 5. MORGUE
Eastern base
Dredge on bottom UTC 17/12/02 0021hrs, lat 42º42.687'S, long 179º57.049'W, depth 1185m
Dredge off bottom UTC 17/12/02 0132hrs, lat 42º42.830'S, long 179º57.182'W, depth 1025m
700kg, dredge 2/3 full. Vesicular & amygd olivine basalts and brown volcanic breccia. One silicified/phosphatised bone

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR5-1	7x7x5 cm subrounded	grey, vesicular (1-3 mm, 10-15%) olivine (5%) microporphyritic basalt. A few ?phosphate vesicle infillings	Y	Y	Y					best piece from dredge. Olivine is partly to totally altered
DR5-2	20x20x15 cm sculpted subrounded	olivine basalt same as DR5-1, grey	Y	Y	Y			Y		
DR5-3	7x5x5 cm subrounded	olivine basalt same as DR5-1, grey	Y	Y	Y					2mm ?glauconite coating
DR5-4	20x15x15 cm subrounded	grey vesicular olivine microporphyritic basalt; similar to DR 5-1, but vesicles ~20%	Y	Y	Y					minor sil/phos material and zeolite in vesicles
DR5-5	20x20x20 cm subrounded	grey to slightly brownish olivine basalt								5-10% vesicles
DR5-6	10x20x30 slab	brown volcanic breccia, altered	Y							cemented with phosphatic material
DR5-7	two 5x3x3 cms, blocky subrounded corners	quartzofeldspathic granofels (?) with chlorite. Possibly a xenolith or dropstone	Y							
DR5-8	15x15x15 cm subangular	brownish-white volcanic breccia cemented by ?zeolite						Y		
DR5-9X	15x15x15 cm subrounded	brownish grey vesicular/amygd olivine basalt, similar to DR 5-1 to 6					Y			more vesicle infilling + veining than DR 5-1 to 6
DR5-10X	20x20x20 cm subrounded	similar to DR 5-9X					Y			
DR5-11X	10x10x10 cm subrounded	brown volcanic breccia					Y			white ?zeolite or siliceous cement
DR5-12X		similar to DR 5-11X					Y			
DR5-13X		similar to DR 5-11X					Y			
DR5-14X	10x10x7 cm subrounded	similar to DR 5-9X					Y			~ 30% vesicles/amygdules
DR5-15X	20x20x15 cm rounded	brown volcanic breccia with some grey vesicular clasts					Y			
DR5-16X	12x10x7 cm subangular	brown volcanic breccia					Y			
DR5-17X	20x20x10 cm subrounded slab	grey-brown amygdaloidal olivine basalt					Y			
DR5-18X	20x15x7 cm subrounded	brownish olivine basalt					Y			8mm Mn rind and blob of white clay between rock + rind
DR5-19X	30x30x20 cm slab	grey-brown vesicular olivine basalt					Y			veined by zeolite
DR5-20	7x5x2 cm friable	glauconitic or vivianitic sandstone						Y		
DR5-21	50x10x5 cm elongate	phosphatised or silicified bone?						Y		shows possible cellular structure. Broke into 2 pieces in dredge
DR5 22X	50x40x30 cm tough boulder	brownish grey olivine basalt					Y			veined but could be fresh material inside

STATION 6. HEADSTONE
East side
Dredge on bottom UTC 17/12/02 0301hrs, lat 42º40.6'S, long 179º57.0'W, depth 1261m
Dredge off bottom UTC 17/12/02 0345hrs, lat 42º40.690'S, long 179º57.362'W, depth 1173m
3kg. Only a few volcaniclastic breccias

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR6-1	15x15x5cm angular slab	lapilli tuff breccia with highly vesicular clasts (up to 3cm). Matrix appears completely altered	2Y			glass				glass palagonitised, but good for EMP?
DR6-2	7x5x5cm rounded	similar to DR6-1, clasts up to 1.5cm	Y							
DR6-3X	eight small fragments	similar to DR6-1and -2					Y			

STATION 7. SHIPLEY A
Middle part of eastern flank
Dredge on bottom UTC 17/12/02 1409hrs, lat 41º49.893'S, long 179º28.195'W, depth 2097m
Dredge off bottom UTC 17/12/02 1517hrs, lat 41º49.491'S, long 179º28.512'W, depth 1773m
0.5kg. One piece each of volcanic breccia, ol px basalt

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR7-1	5x5x2cm subrounded	soft, altered volcanic breccia, 0.3-5mm fine to coarse grain size								larger clasts (5mm) are highly vesicular, carbonate matrix
DR7-2	11x7x5cm	dark brown basalt. 5% orange phenocrysts of 1-3mm altered ?olivine and 7% phenocrysts of 1-4mm grey pyroxene	Y	Y	Y	px				<2mm crust, perhaps phosphorite

STATION 8. SHIPLEY B
Upper part of eastern flank
Dredge on bottom UTC 17/12/02 1654hrs, lat 41º47.71'S, long 179º27.52'W, depth 1811m
Dredge off bottom UTC 17/12/02 1729hrs, lat 41º47.731'S, long 179º27.772'W, depth 1615m
Empty dredge

STATION 9. SHIPLEY C
Near top of south flank
Dredge on bottom UTC 17/12/02 1909hrs, lat 41°50.920'S, long 179°31.414'W, depth 1732m
Dredge off bottom UTC 17/12/02 1951hrs, lat 41°50.541'S, long 179°30.955'W, depth 1534m
500kg, half-full dredge. 95% Mn crusts; suite of cpx + ol pptic and aphyric basalts, volcanic breccias, phosphorite nodules

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR9-1	7cm diameter, well rounded	brownish-olive vesicular (15%), cpx-porphyritic (5%) lava. Possible palagonite rind on sample.	Y	Y	Y	px				Mn-crust <1mm. Cpx is fresh. Some zeolites.
DR9-2	9cm diameter, subrounded	brownish-olive vesicular (10%) ol, cpx (10% phenos) basaltic lava, px is fresh, some zeolite rims in vesicles	Y	Y	Y	px		Y		1cm Mn crust.
DR9-3	6cm diameter, sub rounded	brownish olive, zeolite amygd ol, cpx-pptic basalt. Px is fresh, vesicles 5%, phenocrysts 5%	Y	Y	Y	px				
DR9-4X	4cm diameter subrounded	veined, brownish pyroxene-porphyritic lava with palagonite rind and attached siliceous/phosphatic material				px	Y			
DR9-5	6cm diameter subrounded	red-brown palagonite breccia with zeolite matrix	Y					Y		
DR9-6X	5cm diameter subrounded	red-brown volcanic breccia+ palagonite, zeolite matrix					Y			
DR9-7	6cm diameter, subrounded	breccia with aphyric volcanic clasts (like DR9-13), zeolite cement	Y							
DR9-8X	7cm diameter, subrounded	breccia with aphyric volcanic and some sandstone clasts, zeolite cement					Y			5mm Mn crust
DR9-9	10cm subrounded	light yellow-brown, hard, ?phosphatised limestone (mudstone) nodule. Some planktic forams, dissolved shell fragments, phosphatic oncoids (light brownish), siliciclastics						Y		Some nodular precipitates in cavities, covered by greenish (glauconitic?) crust
DR9-10	10cm diameter subangular	yellowish white hard phosphatised limestone (mudstone). Planktic forams, volcanic? + phosphatic fragments, dendritic Mn-crust, glauconitic?								
DR9-11X	5cm diameter, well rounded	palagonite rind					Y			
DR9-12X	8cm diameter subangular	breccia with Mn-clasts and other volcanic and sedimentary clasts					Y			5mm Mn-rind on outside
DR9-13	10x7x5 cm subrounded	olive brown (outside) to grey (inside) aphyric basaltic lava, only 1 or 2 cpx phenocrysts	Y	Y	Y	px	Y			5mm Mn-rind
DR9-14X	5x5x4cm subangular	same rock type as DR9-13 but more altered: only small cores of grey lava					Y			5mm Mn-rind
DR9-15	three 2mm crystals	crystals growing on outside of Mn-rind								stored in plastic vial
DR9-16Mn	12x10x10cm	breccia (including Mn-crust clasts) cemented by Mn and with a 2cm Mn-crust on the outside							Y	
DR9-17Mn	12x12x10 cm	fairly "clean" 10cm Mn-crust							Y	
DR9-18Mn	10x10x7 cm	fairly "clean" 7cm Mn-crust							Y	
DR9-19Mn	40x30x20cm	Mn crust, on altered volcanic substrate							Y	thickest Mn crust in DR9
DR9-20Mn	40x20x30cm: a fragment of much larger 100x50x20cm slab	Mn crust on some altered volcanic substrate							Y	

STATION 10. SHIPLEY D
Eastern slope of easternmost cone on seamount top
Dredge on bottom UTC 17/12/02 2132hrs, lat 41°48.33'S, long 179°29.03'W, depth 1429m
Dredge off bottom UTC 17/12/02 2207hrs, lat 41°48.08'S, long 179°28.9'W, depth 1340m
Empty dredge

STATION 11. BOLGER
Small cone on eastern flank
Dredge on bottom UTC 18/12/02 0516hrs, lat 41°07.03'S, long 179°45.25'W, depth 1940m
Dredge off bottom UTC 18/12/02 0556hrs, lat 41°07.10'S, long 179°45.55'W, depth 1817m
5kg. Mn crusts only

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR11-1Mn	12x11x4cm with rounded edges	Mn crust							Y	
DR11-2Mn	11x10x3cm	Mn crust							Y	

STATION 12. MOORE A
Upper half of northeastern flank
Dredge on bottom UTC 18/12/02 1416hrs, lat 40º24.797'S, long 179º26.010'W, depth 2312m
Dredge off bottom UTC 18/12/02 1526hrs, lat 40º25.032'S, long 179º26.360'W, depth 2078m
50kg. Jointed aphyric basalt (flow top?) pieces, several Mn crusts, one pumice, one breccia. All of dredge kept.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR12-1	12x12x10cm angular block	hard, brown-grey aphyric nonvesicular fg lava, possibly basalt, or more evolved lava	Y	Y	Y					interior portions less altered. DR12-1 to 5 could be joint blocks from same flowtop?
DR12-2	15x14x10cm subangular	similar to DR12-1 but all brown (altered)	Y							Mn crust 2mm
DR12-3	18x11x11cm subangular	similar to DR12-1 but all brown (altered)	Y					Y		no Mn crust
DR12-4	8x8x6cm subangular	similar to DR12-1 but all brown (altered)	Y							no Mn crust
DR12-5	8x8x8cm subangular	similar to DR12-1 but all brown (altered)								
DR12-6	7x7x2cm subangular	grey-brown calcite amygdaloidal aphyric lava, amygdules up to 10x4mm and flow-aligned	Y	Y						only vesicular lava in this dredge but aphyric nature is similar to other DR12
DR12-7	15x15x10cm rounded	volcaniclastic breccia with pink-grey carbonate cement and some voids	Y					Y		1mm Mn crust
DR12-8	5x3x2cm angular	lava, like DR12-1 with thin, adhering layer of grey sil/phos mudstone								supports flow-top origin for DR12 lavas
DR12-9	9x6x3cm	poorly sorted volcanic breccia with partly vesicular clasts, strongly altered								1mm Mn crust
DR12-10Mn	22x18x7cm	flat slab of Mn crust							Y	
DR12-11X	c. twenty five 7x5x5cm subangular pieces lava	similar to DR12-1 but all brown (altered)					Y			some with 1mm Mn crust
DR12-12X	20x14x7cm rounded cobble	grey-white pumice, partly penetrating Mn crust <5mm					Y			probably from Taupo Volcanic Zone, North Island, New Zealand

STATION 13. MOORE B
Northeastern side of northeastern volcanic cone
Dredge on bottom UTC 18/12/02 1708hrs, lat 40º25.202'S, long 179º26.816'W, depth 1865m
Dredge off bottom UTC 18/12/02 1755hrs, lat 40º25.425'S, long 179º27.216'W, depth 1605m
300kg, quarter full dredge. 90% Mn crusts but some scoriaceous ol pptic basalt, palagonitic breccia and calcareous sedimentary rocks

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR13-1	15x20x5cm angular slab	grey-brown hard calcite amygd (20%) olivine pptic (5%) scoriaceous basalt	Y	Y	Y			Y		In depositional contact with breccia like DR13-6
DR13-2	8x7x3cm subangular	mod hard, orange, altered ?basalt. 5% phenocrysts may once have been olivine: now repl by apple-green ?epidote	Y	Y						epidote alteration?
DR13-3	6x4x8cm subrounded	similar to DR13-1 but separate piece								
DR13-4	5x3x8cm subangular	similar to DR13-1 but separate piece								
DR13-5	4x3x5cm subrounded	Mn cemented volcanic palagonitic breccia. Clasts <5cm	Y							
DR13-6	9x6x9cm subrounded	calcite-cemented volcanic palagonitic breccia. Clasts <1cm	Y							
DR13-7	11x10x13cm subrounded	volcanic palagonitic breccia, similar to DR13-6 but less calcite	Y					Y		No Mn rind
DR13-8	6x6x7cm subrounded	volcanic palagonitic breccia, similar to DR13-6 but less calcite					Y			
DR13-9	8x4x8cm subangular	hard, light yellow-greyish limestone (mudstone) with planktic forams, vesicular volcanic clasts ~1cm					Y	Y		Borings. Hardground?
DR13-10	6x4x10cm subrounded	hard, light yellow-greyish limestone (mudstone) with planktic forams and shell fragments, v few volcanic clasts					Y	Y		Mn crust and dendrites
DR13-11	10x5x14cm subrounded lump	volcanic breccia with limestone matrix. Abundant mm-cm vesicular volcanic frags. No obvious fossils.					Y			Has Mn crust
DR13-12	14x9x18cm subrounded	volcaniclastic sandstone, coarse grained. Some carbonate matrix.					Y			5-15mm Mn rind all around sample.
DR13-13	8x4x8cm subangular	volcanic palagonitic breccia, similar to DR13-6 but less calcite					Y			
DR13-14	11x9x4cm angular	volcanic palagonitic breccia, similar to DR13-6 but has limestone matrix that supports clasts. Planktic forams visible					Y			Contains large ?boring
DR13-15	9x4x12cm subangular	hard, limestone (wackestone), abund. planktic (Paleogene?) and few (larger) benthic forams. Abund. yellow-brown vesicular volcanic fragments.					Y	Y		Mn crusted
DR13-16	24x11x40cm subrounded nodule	Mn nodule. 6cm rind surrounds breccia core							Y	
DR13-17	12x9x10cm subrounded nodule	5cm Mn rind surrounds breccia core							Y	
DR13-18	20x8x23cm flat subangular slab	Mn crust							Y	
DR13-19	10x10x14cm subangular	Mn crust with breccia inside, at base							Y	

STATION 14. MOORE C
Southern flank
Dredge on bottom UTC 18/12/02 2134hrs, lat 40º33.467'S, long 179º30.200'W, depth 2421m
Dredge off bottom UTC 18/12/02 2230hrs, lat 40º33.09'S, long 179º30.05'W, depth 2156m
Empty dredge

STATION 15. MOORE D
Southernmost cone on plateau
Dredge on bottom UTC 19/12/02 0033hrs, lat 40º26.80'S, long 179º27.81'W, depth 1932m
Dredge off bottom UTC 19/12/02 0134hrs, lat 40º26.71'S, long 179º27.13'W, depth 1651m
50kg. Mn nodules and thick crusts; only a couple with corroded sandstone nuclei

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR15-1	7x5x2cm subrounded	volcaniclastic sandstone in core of 15x15x7cm Mn nodule	Y					Y		
DR15-2Mn	13x7x17cm rounded	Mn nodule							Y	
DR15-3Mn	15x12x9cm rounded	Mn nodule							Y	
DR15-4Mn	8x7x12cm rounded	Mn nodule with 2x1cm piece of volcaniclastic sandstone in core							Y	
DR15-5Mn	12x14x21cm rounded	Mn nodule							Y	No archive samples

STATION 16. MOORE PLAIN
Flat area c. 5nm NE of Moore Seamount
TV-grab over side UTC 19/12/02 0320hrs, lat 40º20.738'S, long 179º23.601'W, depth 3015m, cable 2m
TV-grab on bottom UTC 19/12/02 0426hrs, lat 40º20.746'S, long 179º23.647'W, depth 3015m, cable 2996m
TV-grab closed UTC 19/12/02 0445hrs, lat 40º20.713'S, long 179º23.617'W, depth 3014m, cable 3018m
TV-grab on deck UTC 19/12/02 0600hrs, lat 40º20.723'S, long 179º23.594'W, depth 3014m
TV-grab didn´t close right: not much sediment

STATION 17. MOORE PLAIN
Flat area c. 5nm NE of Moore Seamount
box corer over side UTC 19/12/02 0638hrs, lat 40º20.710'S, long 179º23.625'W, depth 3014m
box corer on bottom UTC 19/12/02 0748hrs, lat 40º20.702'S, long 179º23.677'W, depth 3014m
box corer on deck UTC 19/12/02 0846hrs, lat 40º20.74'S, long 179º23.39'W, depth 3011m
box corer deformed, sampling was not possible. Box corer empty

STATION 18. ROWLING A
Eastern slopes
Dredge on bottom UTC 19/12/02 1754hrs, lat 39º38.176'S, long 179º19.289'E, depth 2753m
Dredge off bottom UTC 19/12/02 1850hrs, lat 39º38.39'S, long 179º19.13'E, depth 2500m
50kg. Mainly volcanic breccias, some vesicular ol pptic lavas, 2 separate Mn-crusts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR18-1	16x9x5cm, angular	grey vesicular (20%), sparsely (<2%) olivine (alt) phyric basalt with adhering palagonite breccia, some zeolite amygdules	Y	Y	Y			Y		Olivine altered
DR18-2	10x6x6cm, subrounded	grey, vesic to zeol-amygd (20%), olivine-phyric (1%), basalt with palagonite rind, probably a small pillow fragment	Y	Y						NM photo
DR18-3	6x4x4cm, subangular	similar rock to DR18-1 + 2 but ~10% vesicles/ amygdules, olivine (alt) and plagioclase in groundmass	Y	Y						
DR18-4	11x9x5cm, subrounded	palagonitic breccia with vesicular lava like DR18-1 as a large clast	Y							NM photo, TS of clast and breccia contact
DR18-5	7x5x4cm, angular	similar to DR18-4 but palagonite is perhaps more promising for fresh glass	Y*			Y				MAKE A SPECIAL THIN SECTION OF THIS SAMPLE
DR18-6	6x3x5cm, angular	amygdaloidal, sparsely ol-phyric basalt, similar to DR18-1								
DR18-7	7x6x4cm, subrounded	similar to DR18-1								
DR18-8	8x4x5cm, angular	similar to DR18-1								
DR18-9	12x10x8cm, subangular	dark brown palagonite breccia, some clasts of holocrystalline lava, amygdaloidal like DR18-1						Y		
DR18-10	14x10x4cm, small slab	green-brown matrix-supported indurated volcanic breccia	Y					Y		
DR18-11	12x8x6cm, well rounded	greenish volcanic-palagonitic breccia with calcite cement, clasts mainly vesicular olivine basalt like DR18-1						Y		
DR18-12	13x10x8cm, sub rounded	orange coloured breccia, otherwise similar to DR18-11	Y					Y		
DR18-13	8x6x5cm, rounded	orange, bedded + graded (1-5mm), very coarse to medium grained volcaniclastic sandstone, calcite cement						Y		
DR18-14	7x7x4cm, slab	yellowish sandstone, volcaniclastic, fine-medium grained						Y		
DR18-15	10x8x4cm	Mn-crust							Y	
DR18-16	10x8x5cm	Mn-crust							Y	no archive samples

STATION 19. ROWLING B
Small cone from base to top on NE slope
Dredge on bottom UTC 20/12/02 2215hrs, lat 39º33.39'S, long 179º13,45'E, depth 2660m
Dredge off bottom UTC 20/12/02 2248hrs, lat 39º33,65'S, long 179º13,66'E, depth 2512m
2kg. Mn crusted palagonitic breccias, one highly vesicular plag basalt clast with some fresh glass

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR19-1	5x4x9cm, subrounded	highly vesicular (60%) lava from volcanic breccia; kernels of fresh black glass; rare feldspar phenocrysts up to 4 mm	Y	Y	Y	glass fsp				loose clay fills 1/2 vesicles: ultrasound
DR19-2	4x3x3cm subrounded	similar to DR19-1	Y	Y		fsp				
DR19-3	4x4x9cm	red-brown palagonitic volcanic breccia with altered clay matrix						Y		Mn-crust (5mm)
DR19-4	4x4x11cm	similar to DR19-3, (5mm Mn-crust)								
DR19-5	5x6x10cm	similar to DR19-4 with 2cm Mn-crust								
DR19-6	5x9x13cm	palagonitic fine breccia with 0.5-2cm Mn-crust						Y		
DR19-7	3x6x8cm	similar to DR19-5 with 0.5 cm Mn-crust								
DR19-8	5x4x7cm	similar to DR19-6 with 0.5 cm Mn-crust								
DR19-9Mn	3x3x4cm and 5x3x3cm, angular	similar to DR19-4 with 1.5-2cm Mn-crust								no archive or Mn samples

STATION 20. KIRK A
Steep WSW flank
Dredge on bottom UTC 20/12/02 0420hrs, lat 39º26.95'S, long 179º50.95'E, depth 2960m
Dredge off bottom UTC 20/12/02 0528hrs, lat 39º26.93'S, long 179º51.42'E, depth 2597m
Empty dredge

STATION 21. KIRK B
Canyon on steep WSW flank
Dredge on bottom UTC 20/12/02 1024hrs, lat 39º29,14'S, long 179º52,87'E, depth 2886m
Dredge off bottom UTC 20/12/02 1154hrs, lat 39º28.895'S, long 179º53.493'E, depth 2378m
30kg, Mn crusted non-vesicular olivine basalts; some breccia

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR21-1	7x4x4cm angular	dark grey olivine microphyric (1-5%) basalt. Not vesicular. No Mn crust	Y	Y	Y					
DR21-2	6x5x3cm angular	grey-brown lava, similar to DR21-1but moderately altered	Y	?						Very thin Mn crust
DR21-3	14x7x6cm angular	brown lava with Mn and yellow-white rinds and veins. Similar to DR21-1 but strongly altered	Y	?						Amygdaloidal
DR21-4XMn	37x18x10cm subrounded	altered (especially rim) brown lava, some 1-2mm amygdules otherwise similar to DR21-1.					Y	Y	Y	3cm Mn crust removed from archive sample
DR21-5	9x7x6cm angular	grey-brown lava, some amygdules, 1% altered olivine phenocrysts, similar to DR21-1but moderately altered and veined							Y	2cm Mn crust removed from reference sample
DR21-6	7x4x4cm angular	similar to DR21-5 but slightly more altered								
DR21-7	11x6x5cm subrounded	red-brown volcanic breccia with poorly sorted ang-rounded lava fragments (not palagonitic). Soft, white, noncalcareous cement.	Y					Y		
DR21-8	14x6x5cm angular	dark brown volcanic breccia, clasts 1-10mm, 50% yellowish-white soft noncalc matrix (probably zeolite)								3cm Mn crust
DR21-9X	8x7x5cm	lava similar to DR21-3					Y			
DR21-10X	7x5x4cm	lava similar to DR21-2					Y	Y		
DR21-11X	10x9x7cm	lava similar to DR21-5					Y			
DR21-12X	12x6x5cm	lava similar to DR21-5					Y	Y		
DR21-13X	10x4x4cm	lava similar to DR21-5					Y			
DR21-14X	5x5x5cm	lava similar to DR21-5					Y			
DR21-15X	6x5x4cm	lava similar to DR21-5					Y			
DR21-16X	8x5x4cm	lava similar to DR21-5					Y			
DR21-17X	14x10x5cm	volcanic breccia, brown and green clasts, otherwise similar to DR21-7					Y	Y		
DR21-18X	20x9x4cm	volcanic breccia similar to DR21-7					Y			
DR21-19X	7x5x5cm	volcanic breccia similar to DR21-8					Y			

STATION 22. KIRK C
Small cone halfway down steep SSW flank
Dredge on bottom UTC 20/12/02 1400hrs, lat 39º32.110'S, long 179º54.771'E, depth 2918m
Dredge off bottom UTC 20/12/02 1704hrs, lat 39º32.252'S, long 179º54.644'E, depth 3045m (dredge was stuck for 3 hours on bottom)
15kg, yellow and grey volcanic breccias, Mn crusted. Some cc amygdaloidal olivine basalts as breccia clasts.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR22-1	16x10x9cm subrounded	dark brown basalt, highly (30%) vesicular (outer part) to calcite amygdaloidal (inner part). 1% altered olivine phenocrysts.	Y	Y				Y		<3mm Mn crust
DR22-2	5x4x2cm angular	dark brown lava similar to DR22-1								<3mm Mn crust
DR22-3	7x6x4cm subrounded	brown-black lava thoroughly penetrated by Mn (no good for chemistry). Some adhering volcanic breccia: lava is probably a clast								
DR22-4	7x5x4cm subrounded	brown (interior) to yellow (clay altd rim) olivine (altd)-phyric (5%), vesicular & amygdaloidal (10%) lava clast in breccia.								calcite and yellow clay in amygdules
DR22-5	21x21x14cm subrounded	volcanic breccia with yellow (altd) and brown (mod fresh) ol basalt clasts. Olivine is altered. Calcite matrix. Mn crust <1cm.	Y					Y		possibility of more lava clasts to work on from this sample.
DR22-6X	16x10x4cm angular	volcanic breccia similar to DR22-5, some drusy calcite in matrix cavities					Y			
DR22-7X	10x7x5cm subrounded	similar to DR22-6X					Y			
DR22-8X	20x20x15cm subrounded	similar to DR22-6X					Y			
DR22-9X	21x15x15cm subrounded	similar to DR22-6X					Y			
DR22-10X	8x7x3cm subrounded	similar to DR22-6X					Y			
DR22-11X	6x5x4cm subrounded	similar to DR22-6X					Y			
DR22-12X	6 pieces approx 7x6x2cm	similar to DR22-6X					Y			mainly Mn crust

STATION 23. PALMER A
W side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 0316hrs, lat 39º32.390'S, long 178º30.747'W, depth 3183m
Dredge off bottom UTC 21/12/02 0408hrs, lat 39º32.291'S, long 178º30.291'W, depth 2974m
300kg, single subrounded 1x0.5x0.5m Mn boulder with phosphatic and corroded volcanic breccia interior. Hammered to pieces on deck

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR23-1x	10x10x10cm sawn slab of boulder core	Mn corroded and enclosed volcanic breccia with yellowish 1cm clasts of olivine (alt) phyric amygdaloidal basalt	Y				Y	Y		general note: the 1x0.5x0.5m boulder has composite internal apprerance. It could be smaller samples brecciated and cemented together and replaced and coated by more Mn
DR23-2x	10x10x10cm sawn slab	bored phosphate nodule. From interior part of large bldr.					Y	Y		This hard, noncalc material also forms matrix to brecciated Mn rinds within the boulder. Berning has a piece for fossil ID
DR23-3Mn	sawn half of 15x10x10cm rounded cobble	4cm radius Mn nodule adhering to outside top of main boulder.							Y	
DR23-4Mn	20x20x20cm	interior part of large boulder, brecciated + phosphatic cemented nested Mn nodules, some with breccia cores							Y	
DR23-5Mn	Sawn half of 15x15x15cm piece	thickest 'clean' exterior 10 cm rind on boulder. Rock core.							Y	

STATION 24. PALMER B
NW side of highest small cone W of end of Palmer ridge
Dredge on bottom UTC 21/12/02 1107hrs, lat 39º31.209'S, long 178º34.994'W, depth 3202m
Dredge off bottom UTC 21/12/02 1148hrs, lat 39º31.412'S, long 178º34.698'E, depth 2912m
Empty dredge

STATION 25. PALMER C
NW side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 1405hrs, lat 39º31.641'S, long 178º29.951'W, depth 3134m
Dredge off bottom UTC 21/12/02 1453hrs, lat 39º31.884'S, long 178º29.672'W, depth 2881m
20 kg, mostly Mn encrusted breccia, some amygdaloidal olivine basalts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR25-1	7x5x5cm, subangular	brown-grey basalt, vesicular (8%, < 2mm), small orange altered olivines (3%, size < 2mm), 30% of the vesicles are filled with yellowish ?clay material	Y	Y	Y			Y		Mn-crust < 4mm cut off from geochemistry sample, olivine is altered
DR25-2	8x6x6cm subangular	dark brown and highly amygdaloidal (30%) basalt, vesicles up to 7 mm, mostly filled with white, hard ?phosphatic material, others are opensmall amount of altered orange olivine phenocrysts (<3mm)								
DR25-3	13x7x6cm, subrounded	volcanic breccia with poorly sorted (0.5mm - 2cm), ang & rounded vesicular dark brown and yellow-white lava clasts						Y		
DR25-4	15x12x10cm, rounded	volcanic breccia, very poorly sorted (mm-2cm), big clasts are vesicular (15%, < 2 cm), rounded, brown (light to dark), matrix is light brown and soft						Y		Mn-crust < 2mm
DR25-5X	3 pieces, all ~20x15x15cm, subrounded	same as DR25-4					Y			
DR25-6X	14x8x5cm, rounded	volcanic breccia, clasts are poorly sorted, yellow-brown, vesicular (15%, <3mm), matrix is Mn-crust					Y			breccia has a < 1:5cm Mn-crust
DR25-7X	15x8x5cm, rounded	same as DR25-6X					Y			

STATION 26. LANGE A
Small cone at SW base
Dredge on bottom UTC 22/12/02 0145hrs, lat 39º06.09'S, long 177º30.20'W, depth 3509m
Dredge off bottom UTC 22/12/02 0255hrs, lat 39º06.14'S, long 177º30,49'W, depth 3285m
10 kg. Brown vesicular aphyric lavas and brown-yellow Mn crusted breccias

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR26-1	7x6x5cm subrounded	black-brown aphyric lava, 25% 2-4mm vesicles	Y	Y	Y					
DR26-2	7x7x5cm subrounded	brown aphyric lava, 15% 1-2mm vesicles	Y					Y		
DR26-3	9x9x5cm subrounded	brown aphyric lava clast (20% vesicles <1mm) from volcanic breccia DR26-5								
DR26-4	11x7x5cm subrounded	volcanic breccia with clast of orange-grey non-vesicular olivine-phyric basalt								
DR26-5	22x14x12cm subrounded	hard volcanic breccia with numerous 2-6cm clasts of brown vesicular aphyric lava. Yellow-orange matrix.	Y					Y		
DR26-6X	9x6x4cm subrounded	orange-brown palagonitic volcanic breccia								1cm Mn crust
DR26-7X	a few 10x10x5cm pieces	volcanic breccia similar to DR26-5								max 2cm Mn crust
DR26-8X	two 11x9x6cm & 6x6x3cm	lava, similar to DR26-5 clasts								

STATION 27. LANGE B
Small cone on SW edge Lange plateau
Dredge on bottom UTC 22/12/02 0516hrs, lat 39º03.30'S, long 177º28.01'W, depth 2644m
Dredge off bottom UTC 22/12/02 0631hrs, lat 39º02.95'S, long 177º28.10'W, depth 2338m
15 kg, Mn crusts up to 10cm thick. Traces of corroded and replaced cores of volcanic or volcaniclastic material

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR27-1Mn	10x7x15cm sawn piece	Mn crust							Y	
DR27-2Mn	20x20x10cm sawn piece	Mn crust							Y	separate piece in dredge
DR27-3	2x1x1cm subrounded	corroded and replaced ?lava fragment in middle of Mn nodule						Y		Most of dredge discarded

STATION 28. LANGE C
NE trending canyon on E flank of seamount
Dredge on bottom UTC 22/12/02 1059hrs, lat 39º02.080'S, long 177º15.881'W, depth 3102m
Dredge off bottom UTC 22/12/02 1147hrs, lat 39º02.180'S, long 177º16.354'W, depth 2922m
Empty dredge

STATION 29. KATZ
Head of E trending canyon on E side of seamount
Dredge on bottom UTC 22/12/02 1714hrs, lat 38º46.519'S, long 176º57.421'W, depth 3116m
Dredge off bottom UTC 22/12/02 1814hrs, lat 38º46.269'S, long 176º57.699'W, depth 2828m
200kg. Two thirds fresh olivine (altd) and plagioclase (fresh)-phyric basalts; one third volcanic breccias

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR29-1	11x13x5cm subangular	fresh, grey nonvesicular basalt with 3mm olivine phenocrysts (altered, 2%) and 2mm long plagioclase microphenocrysts (fresh, 10%)	Y	Y	Y	fsp		Y		Best lava of the cruise so far
DR29-2	10x7x5cm subangular	fresh, grey nonvesicular basalt with 5mm olivine phenocrysts (altered, 3%) and 1mm plagioclase microphenocrysts (fresh, 15%)	Y			fsp				Olivine slightly coarser grained and more abundant than DR29-1
DR29-3	18x10x7cm subangular	fresh, grey nonvesicular basalt with 7mm olivine phenocrysts (altered, 5%) and 1mm plagioclase microphenocrysts (fresh, 20%)				fsp				More porphyritic than DR29-1 and DR29-2
DR29-4	13x6x5cm subangular	similar to DR29-2 but sample shows section from chilled (altered glassy) margin to medium grained interior.								Possibly a small columnar joint from the lava flow
DR29-5	9x7x4cm angular	Light brownish grey phosphatised limestone. No reaction with HCl. No forams or clastic grains visible.						Y		
DR29-6	6x6x5cm angular	Yellowish white phosphatised limestone. No reaction with HCl. No forams or clastic grains visible.						Y		
DR29-7	28x25x10cm angular slab	grey-brown brecciated basalt. 10mm plagioclase phenocrysts (fresh, 7%) abd 1-2mm olivine phenocrysts (altered, 1%).	Y	Y	Y	fsp		Y		5cm Mn crust. Lava sample is from slab of yellow-brown volcanic breccia.
DR29-8	13x9x6cm subrounded	brownish palagonitic breccia	Y					Y		
DR29-9X	17x16x8cm subangular	brown, vesicular (15%) lava with altered olivine phenocrysts (3%, max size 3mm)					Y			
DR29-10X	17x12x8cm subangular	lava similar to DR29-3					Y			
DR29-11X	15x12x6cm piece	yellow-brown palagonitic volcanic breccia. Lava clast shows section from chilled margin to medium grained interior					Y			
DR29-12X	16x13x4cm piece	yellow-green zeolite-cemented volcanic breccia with distinctive feldspars up to 15mm long.					Y			Possibly eroded from lavas like DR29-7.
DR29-13X	13x13x8cm	Similar to DR29-8					Y			

STATION 30. MULDOON
Small canyon on E side of seamount
Dredge on bottom UTC 23/12/02 0435hrs, lat 38°30.45'S, long 176°34.90'W, depth 3634m
Dredge off bottom UTC 23/12/02 0535hrs, lat 38°30.20'S, long 176°35.22'W, depth 3341m
0.1kg. Single small piece of vesicular olivine basalt, fairly fresh

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR30-1	7x6x4cm angular	vesicular (25%) dark grey-brown olivine porphyritic (2%, 4mm size) basalt	Y	Y	Y			Y		loose clay in vesicles but otherwise fairly fresh. Fsp visible in fg groundmass. No Mn rind.

STATION 31. MARSHALL
East flank
Dredge on bottom UTC 23/12/02 1938hrs, lat 38°2.14'S, long 177°28.75'W, depth 2974m
Dredge off bottom UTC 23/12/02 2044hrs, lat 38°01.99'S, long 177°29.43'W, depth 2587m
Empty dredge

STATION 32. KIWI RIDGE A
Top area, 4th small hill from south small canyon
Dredge on bottom UTC 25/12/02 0259hrs, lat 36°18.8'S, long 178°49.2'W, depth 4443m
Dredge off bottom UTC 25/12/02 0416hrs, lat 36°18.743'S, long 178°49.948'W, depth 4133m
15kg. Yellow, orange & brown hyaloclastite and volcanic breccias; some grey zeol-amygd olivine basalts; mudstone; Mn-rinds

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR32-1	4x3x3cm, subangular	black vesicular basalt, olivine phenos (2mm, 3%) , vesicles (1mm, 25%) part filled with zeolite, Yellow hyaloclastite rind.	Y	Y	Y					2mm Mn-rind
DR32-2	5x5x4cm, subangular	grey brown vesic/amygd basalt with orange, glassy rind. Olivine phenos (1mm, 2%), vesicles part zeolite filled (<1mm, 20%). Basalt has outer rind of adhering yellow hyaloclastite	Y	Y		?				Veined with beige cryptocrystalline phosphate
DR32-3	5x5x5cm, subangular	similar to DR32-2 but 1mm vesicles	Y							
DR32-4	7x6x5cm subangular	grey vesicular basalt similar to DR32-1. Prominent 1mm wide vein of beige phosphate						Y		1mm Mn-crust
DR32-5	10x8x7cm, subangular	yellow, black & brown volcanic breccia. Clasts of lava + amygdaloidal glass like DR32-4, variably devitrified and alt to bright yellow clay & zeolite.	Y					Y		1mm Mn-crust. Same siliceous-looking but soft veins + cement (like DR32-2 & 4)
DR32-6	8x5x5cm, subrounded	yellow + orange hyaloclastite-palagonitic breccia, similar to DR32-5 but containing more altered orange glass	Y							<1mm Mn-rind
DR32-7	10x9x8cm, subangular	volcanic breccia, similar to DR32-5								1cm Mn-rind
DR32-8	originally 20x15x15cm lump	pale brown weakly indurated limestone (mudstone), non-calcareous and possibly tuffaceous						Y	Y	Sample has "clean" 3cm Mn-rind. Mn also penetrates mudstone to 4-5cm depth
DR32-9X	6x6x6cm	volcanic breccia, similar to DR32-5&6					Y			
DR32-10X	9x7x7cm	volcanic breccia, similar to DR32-9X					Y			

STATION 33. KIWI RIDGE B
5th cone, upper eastern slope
Dredge on bottom UTC 25/12/02 0715hrs, lat 36°16.93'S, long 178°49.05'W, depth 4470m
Dredge off bottom UTC 25/12/02 0815hrs, lat 36°16.914'S, long 178°49.568'W, depth 4139m
30kg. Vesicular-amygdaloidal olivine basalts. Zeolite & calcite alteration.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR33-1	5x7x5cm, angular	grey vesicular-amygd olivine (<1%, 1-2mm, alt) basalt. 25% vesicles (0.2-1mm diameter), unfilled in the center of the piece	Y	Y	Y					5mm Mn crust (cut off)
DR33-2	10x8x10cm	grey vesicular lava, similar to DR33-1 but more strongly altered, vesicle size increase towards center (0.2-2cm).	Y	Y						outermost 1cm is calcite-filled then 2cm of mostly open vesicles
DR33-3	10x10x10cm	grey vesicular lava, similar to DR33-1	Y	Y						1cm Mn-crust (cut off)
DR33-4	8x4x3cm, subangular	grey amygdaloidal lava, same features as DR33-1, 80% of vesicles filled with cc	Y	Y						<<1mm Mn-crust
DR33-5	30x20x13cm	grey lava fragment, similar to DR33-1 but most vesicles are filled with cc	Y	Y				Y		5mm Mn crust. Cut center piece for geochemistry
DR33-6	25x20x10cm	similar to DR33-5	Y	Y						
DR33-7X	different sized lava pieces	all similar to DR33-1 but different in degree of alteration and vesicle size					Y			
DR33-8X	see DR33-7X	see DR33-7X					Y			
DR33-9X	see DR33-7X	see DR33-7X					Y			
DR33-10X	see DR33-7X	see DR33-7X					Y			
DR33-11X	see DR33-7X	see DR33-7X					Y			
DR33-12X	see DR33-7X	see DR33-7X					Y			
DR33-13X	see DR33-7X	see DR33-7X					Y			

STATION 34. RAPUHIA A

Steep, single scarp

Dredge on bottom UTC 25/12/02 1439hrs, lat 35º59.497'S, long 178º31.199'W, depth 6182m

Dredge off bottom UTC 25/12/02 1644hrs, lat 36º00.027'S, long 178º31.875'W, depth 5399m

1300kg. Volcanic breccias and sandstones. 5% of dredge is cpx-plag basalt, dolerite & gabbro. Includes a 1x1x0.5m boulder of fg sandstone.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR34-1	10x10x8cm subangular	grey-brown fg basalt. Vesicular-amygdaloidal (10%, 2mm) ?chlorite/celadonite part fills vesicles. Aphyric but plag & cpx in groundmass.	Y	Y	Y			Y		Least-filled vesicles of DR34-1,2,3.
DR34-2	5x5x4cm subrounded	grey-brown fg basalt. Chlorite amygdaloidal (irreg shaped, 10%, 1-2mm). Aphyric but plag & cpx in groundmass.	Y							
DR34-3	10x8x6cm subrounded	olive-brown fg basalt, aphyric, amygdaloidal (10%, 3mm).	Y							
DR34-4	12x10x6cm sawn fresh part of larger subang block	grey fg basalt, aphyric, nonvesicular. Plag, px, Fe-Ti oxide visble.	Y	Y	Y			Y		Possibly best basalt
DR34-5	10x10x10cm subangular	brownish-grey feldspathic fine grained aphyric, nonvesicular basalt. Plag, cpx, Fe-Ti oxide in groundmass	Y							
DR34-6	12x10x8cm subangular	greenish-grey, fine-med grained ?chlorite amygdaloidal (10%, 3mm) and veined (same min as amygs) basalt. Similar mineralogy to DR34-5	Y							
DR34-7	11x9x8cm subangular	orange-grey med grained aphyric, nonvesicular basalt. Cpx, plag, Fe-Ti oxide in groundmass	Y							
DR34-8	8x8x7cm subangular	dark orange grey medium grained equigranular basalt-dolerite. Cpx, plag, Fe-Ti oxide	Y							
DR34-9	10x9x4cm subangular	dark orange grey med-coarse grained dolerite. Cpx, plag, Fe-Ti oxide.	Y	Y				Y		
DR34-10	12x6x6cm subangular	similar to DR34-9	Y							
DR34-11	10x9x4cm subangular	orange and grey altered gabbro. Some pyroxene is porphyritic. Cpx, plag, Fe-Ti oxide	Y	Y		fsp		Y		
DR34-12	8x8x6cm subangular	orange and grey altered ophitic gabbro. Some pyroxene is porphyritic. Cpx, plag, Fe-Ti oxide	Y			fsp				
DR34-13X	20x15x10cm subanhgular	grey-green polymict volcanic breccia	Y				Y	Y		
DR34-14X	15x10x10cm subangular	grey-green polymict volcanic breccia, more poorly sorted than DR34-13					Y			
DR34-15X	15x10x10cm rounded	dark brown mod well sorted granule conglomerate-breccia, volcaniclastic					Y	Y		
DR34-16X	25x20x10cm slab	grey-green v coarse volcaniclastic sandstone					Y	Y		
DR34-17X	15x10x8cm rounded	brown, laminated bedded coarse grained volcaniclastic sandstone					Y			
DR34-18X	15x15x10cm subrounded	olive-brown laminated medium grained volcanic sandstone					Y	Y		
DR34-19	7x5x4cm subrounded	red-brown volcaniclastic pebbly sandstone, possibly with accretionary lapilli or ooid-like intraclasts	Y					Y		
DR34-20X	10x10x4cm rounded	pale brown voclaniclastic sandstone					Y			
DR34-21X	8x7x4cm subangular	orange volcaniclastic sandstone					Y			
DR34-22X	10x7x5cm subangular	pale orange volcaniclastic sandstone					Y			
DR34-23X	10cm rounded	green voclaniclastic siltstone-mudstone					Y			
DR34-24X	7x7x6cm subrounded	brick red volcaniclastic siltstone-mudstone					Y	Y		
DR34-25X	from 1x0.5x0.5m subangular boulder	orange-grey fine grained pebbly sandstone					Y			size & angularity indicate possibly only in situ rock at dredge site?
DR34-26X	one of four 7-12 cm subangular pieces	altered amygdaloidal lava					Y			
DR34-27X	one of four 7-12 cm subangular pieces	altered amygdaloidal lava					Y			
DR34-28X	one of four 7-12 cm subangular pieces	altered amygdaloidal lava					Y			
DR34-29X	one of four 7-12 cm subangular pieces	altered amygdaloidal lava					Y			
DR34-30X	one of four 5-30 cm subangular pieces	altered nonvesicular basalt-dolerite					Y			
DR34-31X	one of four 5-30 cm subangular pieces	altered nonvesicular basalt-dolerite					Y			
DR34-32X	one of four 5-30 cm subangular pieces	altered nonvesicular basalt-dolerite					Y			
DR34-33X	one of four 5-30 cm subangular pieces	altered nonvesicular basalt-dolerite					Y			
DR34-34X	one of four 7-20 cm subangular pieces	altered dolerite-gabbro					Y			
DR34-35X	one of four 7-20 cm subangular pieces	altered dolerite-gabbro					Y			
DR34-36X	one of four 7-20 cm subangular pieces	altered dolerite-gabbro					Y			
DR34-37X	one of four 7-20 cm subangular pieces	altered dolerite-gabbro					Y			
DR34-38Mn	15x5x4cm sawn piece	orange-brown volcaniclastic sandstone with small, nucleating 1-2mm Mn patches							Y	

STATION 35. MOA
SE flank towards top
Dredge on bottom UTC 25/12/02 2223hrs, lat 36°02.05'S, long 178°16.55'W, depth 5918m
Dredge off bottom UTC 26/12/02 0011hrs, lat 36°01.45'S, long 178°17.22'W, depth 5167m
450kg. Hydrothermally altered aphyric lavas. Many, but small, fresh kernels.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR35-1	10x11x9cm subangular	black, v fine grained slightly vesicular (1mm, 1%) aphyric basalt or int lava	Y	Y	Y					0.5cm yellow-green alteration rind. Freshest sample in dredge.
DR35-2	18x14x10cm angular piece, from c. 0.5m angular boulder	grey, aphyric, nonvesicular basalt. Some alteration spherules in groundmass (to 3mm)	Y	Y	?			Y		
DR35-3	20x13x10cm angular piece, from c. 0.5m angular boulder	similar to DR35-2, alteration spherules to 5mm	Y	Y						
DR35-4	16x12x8cm angular piece from c. 0.5m boulder	similar to DR35-3	Y	Y						
DR35-5	12x9x6cm subangular piece	similar to DR35-3	Y	Y						
DR35-6	12x10x8cm subangular	very altered lava showing different reaction rinds over cm: inner cores of yellowish altered basalt, replaced by soft greenish waxy serpentine-like mineral, in turn veined by red-brown vuggy ?zeolite	Y	Y				Y		probable hydrothermal alteration. Need TS to identify different mineralogical changes
DR35-7	13x4x6cm piece	very altered lava with greenish haloes like DR35-6 but also 7mm whitish alteration spherules.						Y		1mm Mn crust
DR35-8X	11x7x3cm piece	another multiply altered lava. Same greenish replacement but with soft white talcose mineral in veinlets that cut green min.					Y	Y		2mm Mn crust
DR35-9X	20x17x12cm subrounded	very altered basalt, spheroidal/crack controlled infiltration pattern similar to DR35-6 to 8; phenos still visible in green waxy rind	Y				Y	Y		
DR35-10X	22x16x14cm subrounded	unsawn typical piece of altered lava, some waxy gren alteration on the outside					Y			
DR35-11X	6x7x4cm subrounded (2 pieces)	bored brown-grey siltstone (hardground?) with cover and infillings of less indurated yellowish-grey siltstone-mudstone.					Y	Y		Seemingly the only non-lava in the dredge. 1cm Mn crust
DR35-12X	11x9x8cm subrounded	basalt like DR35-2 to 5					Y			
DR35-13X	10x8x6cm piece	basalt like DR35-2 to 5					Y			
DR35-14X	6x6x5cm piece	basalt like DR35-2 to 5					Y			
DR35-15X	10x10x9cm piece	basalt like DR35-2 to 5, large (to 1cm) spheroids					Y			Mn crust 2mm
DR35-16X	12x8x7cm subangular	strongly altered yellow-brown basalt					Y			

STATION 36. RAPUHIA B
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 0436hrs, lat 36°02.28'S, long 178°28.12'W, depth 6001m
Dredge off bottom UTC 26/12/02 0606hrs, lat 36°02.63'S, long 178°28.69'W, depth 5478m
25kg. Weathered lava, dolerite and gabbro; also sedimentary rocks

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR36-1	10x8x7 cm subangular	aphyric basalt strongly altered, >30% spots of Fe staining, chlorite amygdules (1%, <2mm)	Y	Y				Y		thin Mn-crust, << 1 mm
DR36-2	15x15x15 cm subangular	aphyric basalt strongly altered. Abundant Fe staining. Amygdules filled with white-yellow, idiomorphic crysts (small druses), further small vesicles (1%. < 1 mm)	Y	Y						thin Mn-crust, << 1 mm
DR36-3	20x15x8 cm, subrounded	altered aphyric basalt, matrix shows 60% Fe alteration spots (60%)	Y							thin Mn-crust, << 1 mm
DR36-4	10x10x8 cm, subrounded	dolerite, more than 60% of matrix consist of orange Fe stained feldspar, rest probably pyroxene	Y	Y	Y	fsp				Mn-crust << 1 mm
DR36-5	35x17x10 cm, subrounded	gabbro, up to 4 mm grain size. All minerals are strongly altered. 20% olivine, 15 % pyroxene, 65% feldspar orange altered	Y	Y	Y	fsp		Y		Mn-crust << 1 mm
DR36-6	20x15x10 cm, subangular	lava, same as DR36-1, a bit more altered								
DR36-7X	25x15x10 cm, subrounded	lava, same as DR36-3								
DR36-8X	15x10x10x cm, subrounded	gabbro, same as DR36-5								
DR36-9X	15x15x10 cm , rounded	breccia, with 0.1-2cm poorly sorted, orange-black rounded to angular clasts, no reaction with HCl	Y					Y		
DR36-10X	20x20x6 cm, subrounded	poorly sorted breccia like DR38-9X								
DR36-11X	15x15x10 cm subangular	1 piece of siltstone, colour light-greenish-brown, good sorted								<< 1 mm Mn-crust
DR36-12X	10x10x5 cm , subrounded	siltstone, bedded. 5% dark clasts (angular, < 1mm), rest yellow-white								
DR36-13Mn	13x10x5cm subangular	Mn-crust, 4 cm thick on breccia with sedimentary and volcanic clasts								
DR36-14X	15x15x5 cm subangular	lava, Mn-crust (<1mm) with slickensides								slickensides
DR36-15Mn	17x12x7cm , subrounded	Mn-crust, around light brownish-grey soft volcanic mudstone with borings								

STATION 37. RAPUHIA C
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 1112hrs, lat 36º07.242'S, long 178º23.484'W, depth 5868m
Dredge off bottom UTC 26/12/02 1305hrs, lat 36º07.223'S, long 178º23.492'W, depth 5820m
5kg. Sedimentary rocks (mainly sandstones, breccias)

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR37-1	15x13x8 cm, subrounded	polymict breccia. Grey, brown, red clasts 0.1-2cm, rounded-subangular. Pisoliths?). Some clasts (<1%) slightly altered. Noncalc.								Mn-crust << 1mm
DR37-2	15x15x10 cm, subrounded	graded, bedded breccia with rounded-angular clasts of multicoloured basalt, ss and mudstone.								Strong reaction with HCl
DR37-3	10x4x3 cm, rounded	breccia, same as DR37-2								
DR37-4	15x15x6 cm, subrounded	well sorted cg red angular sandstone, 5% dark clasts, grainsize <1-4 mm								
DR37-5	20x13x7 cm, subrounded	sand-siltstone, good sorted, graded layers, fine clasts are dark-brown, coarse ones are gold-brown								no HCl-reaction
DR37-6	15x15x10 and 10x7x6 cm, subangular	breccia with brown-white-black clasts, graded bedding								Mn-crust <<1 mm: no reaction with HCl
DR37-7	18x12x6 cm, subrounded	sandstone, good sorting of brown (60%) and black (40%) clasts, grainsize 0.5 mm								no HCl-reaction
DR37-8	10x8x6 cm subrounded	breccia, quite well sorted with light-dark-brown clasts (subrounded-subangular, <1mm-3mm), only 1 single clast is 2 cm big								Mn-crust < 0,5 mm
DR37-9	10x6x5 cm, subrounded	sandstone, same as DR37-7								
DR37-10	10x10x3 cm, subrounded	sandstone, same as DR37-7								
DR37-11	8x4x4 cm, subangular	1 piece of breccia, same as DR37-8								
DR37-12X	10x10x2 cm, subangular, flat	breccia, clasts poorly sorted (<<1mm - 6 mm), black-white-brown, angular-subrounded								Mn-crust << 1mm. No reaction with HCl
DR37-13X	5x5x2 cm, subangular	breccia, similar to DR37-12x								Mn-crust<<1mm

STATION 38. RAPUHIA D
few miles SE of DR37
Dredge on bottom UTC 26/12/02 1844hrs, lat 36º22.54'S, long 178º07.787'W, depth 5609m
Dredge off bottom UTC 26/12/02 1956hrs, lat 36º23.12'S, long 178º08.22'W, depth 5028m
70kg. Dominated by volcaniclastic rocks, subordinate basalt & dolerite

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR38-1	9x6x4 cm, subangular	med gnd aphyric lava, freshest sample of dredge, grey-green, cpx+plag partly altered	Y	Y	Y					
DR38-2	13x7x6 cm, subangular	lava, similar to 38-1 but veined and more altered	Y	?				Y		
DR38-3	13x11x7 cm, subangular	dolerite-fg gabbro, orange, cpx+plg altered, some greenish minerals, fine grained	Y	?				Y		
DR38-4	13x9x4 cm, angular	dolerite, orange, more cpx than in 38-3, medium grained	Y	?						
DR38-5	9x7x5 cm, subrounded	basalt/dolerite, similar to 38-4 but more cpx, medium to coarse grained	Y	?						
DR38-6	12x11x4 cm, subangular	sandstone(?), yellow-grey, medium grained	Y							
DR38-7	17x16x9 cm, subrounded	volcanic breccia with variable coloured fragments (yellow, orange, olive, black), very coarse grained	Y					Y		
DR38-8x	9x5x3 cm, subangular	volcaniclastic sandstone, brownish, medium grained								
DR38-9x	12x10x5 cm, subrounded	volcanic breccia, orange-grey, coarse to very coarse grained								
DR38-10x	10x7x5 cm, subangular	volcanic breccia, olive, orange, grey, coarse grained								
DR38-11x	10x10x4 cm, subrounded	volcanic breccia, orange-brownish, coarse grained								
DR38-12x	12x6x5 cm, subangular	volcanic breccia, olive-grey, very coarse grained								
DR38-13x	7x4x4 cm, subrounded	volcanic breccia, olive clasts, red matrix, very coarse grained								
DR38-14x	9x10x5 cm, subangular 7x8x6 cm, subangular	volcaniclastic sandstone, brownish, medium grained								
DR38-15x	13x5x7 cm, subangular	volcanic siltstone, yellow part: less altered, 2% brown clasts (<2mm); brown-black part: more altered with Mn-crust, non-regular border between both								
DR38-16x	10x9x7 cm, subrounded	dolerite, orange-black, cpx+plg, medium grained								2mm Mn-crust
DR38-17x	17x13x11 cm, subrounded	dolerite, orange-brownish, medium grained, more altered than 38-16x								<1mm Mn-crust
DR38-18x	15x12x5 cm, subangular	dolerite, orange-brownish, medium grained, similar to 38-17x but some fresher plg?								
DR38-19x	14x10x6 cm, subrounded	dolerite, orange-brownish, medium grained, simiar to 38-17x but fresher plg?								

STATION 39. RAPUHIA E
ca. 1.5 miles E of DR38
Dredge on bottom UTC 26/12/02 2342hrs, lat 36°23.02'S, long 178°06.60'W, depth 5578m
Dredge off bottom UTC 27/12/02 0124hrs, lat 36°23.60'S, long 178°07.25'W, depth 5017m
400kg. 95% grey-brown basalts, variably clay altered. One big boulder palagonite breccia

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR39-1	sawn chips from 30x20x20 cm subangular	fresh grey olivine (altered, 5 %, 2 mm) basalt, fine grained crystalline groundmass.	Y	Y	Y			Y		More altered brownish part of rock sawn off smaller grey parts, and saved separately
DR39-2	sawn chips from 25x25x25 cm subangular	dark grey olivine (altd, 5 %, 2 mm) basalt, fresh grey and more altered brown parts	Y	Y						Needs more work to properly separate fresh grey from altered brown parts
DR39-3	15x10x10 cm subangular	dark brown olivine basalt, equigranular, fine to medium grained, olivines are altered to red clay	Y							matrix is clay rich (muddy on sawing)
DR39-4	15x10x7 cm subangular	pale olive-brown-grey, equigranular, fine to medium grained basalt, olivines are altered to orange clay	Y							matrix is clay rich
DR39-5	15x15x10 cm subangular	olivine (5 %, 1 mm) basalt, brown-grey, equigranular, medium grained, groundmass coarser than DR39-1 to -5	Y					Y		
DR39-6	70x50x50 cm subangular (divided in 5 bags)	hyaloclastite, lapilli tuff. Yellowish matrix (smectite, palagonite), reddish to dark brown glassy clasts up to 10 cm with fresh cores and palagonized rims	Y	Y	Y	Y		Y		FRESH GLASS? Thin (<= 1 cm) Mn-crust
DR39-7x	20x20x10 cm subangular	piece of lava, orange grey								
DR39-8x	15x15x15 cm subangular	piece of lava, orange grey with devitrified glass rind								
DR39-9x	15x12x10 cm subangular	grey-orange lava								
DR39-10x	20x20x15 cm subangular	grey-orange lava								
DR39-11x	25x20x20 cm subangular	grey-orange lava								
DR39-12x	25x15x10 cm subrounded	grey-orange lava, pillow edge								
DR39-13x	30x20x10 cm subangular	grey orange lava								
DR39-14x	20x20x20 cm rounded	yellow, volcaniclastic, finegrained sandstone						Y		
DR39-15x	25x20x10 cm subrounded	piece of palagonite breccia, similar to DR39-6								this was not part of the 70x50x50cm boulder
DR39-16x	5x5x3 cm subrounded	cherty, sedimentary rock, possibly brecciated with Mn								

STATION 40. TUATARA
NW slope, from upper base to top
Dredge on bottom UTC 27/12/02 0708hrs, lat 36°28.03'S, long 177°43.10'W, depth 5076m
Dredge off bottom UTC 27/12/02 0807hrs, lat 36°28.39'S, long 177°42.92'W, depth 4728m
5kg. Moderately hard basalt-dolerite with chlorite-actinolite alteration

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR40-1	10x10x10 cm subangular	1 basalt fragment, light grey to pale greenish matrix , << 0.5 % open vesicles (< 0,5 mm), no phenocrysts except for rare < 0,5 % green minerals, which could be either chlorite or chloritized olivine, or actonilte.	Y	Y	Y					<< 0.5 mm Mn dendrites cut off from geochemistry sample. Rock scratches easily with knife. This basalt is possibly a more evolved lava, and/or more metamorphosed than Rapuhia.
DR40-2	20x10x8 cm subangular	similar to DR40-1, again up to 2 mm green minerals (chlorite or olivine?)	Y	Y	Y					
DR40-3	10x10x10 cm subangular	same as DR40-1, but slightly more abundant open vesicles (~ 1 %) and fractures with small (<< 1 mm) alteration halos	Y	Y	Y					
DR40-4	15x15x10 cm	similar to DR40-1, large fracture with alteration halo	Y	Y	Y			Y		
DR40-5	10x10x10 cm subangular	similar to DR40-1, matrix appears to have more chlorite than sample DR40-1 through DR40-4								
DR40-6	5x5x5 cm	medium altered basalt with light brown matrix, otherwise similar to DR40-1	Y	Y						sample taken for alteration studies
DR40-7	5x5x5 cm	basalt, brown dense matrix, most altered sample of this dredge, serves as endmember for alteration studies	Y	Y						
DR40-8X through DR40-13X		similar to sample DR40-1, but very in degree of alteration						Y		Only DR40-13 to GNS

STATION 41. SAVAGE A
E side of volcanic ridge marking edge of plateau; northern site
Dredge on bottom UTC 27/12/02 1212hrs, lat 36°38.033'S, long 177°47.502'W, depth 4107m
Dredge off bottom UTC 27/12/02 1328hrs, lat 36°38.173'S, long 177°48.173'W, depth 3555m
200kg. One big boulder of Mn-crust 80x50x30 cm

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR41-1Mn	80x50x30 cm, hammered into small pieces	rock has different layers: 3mm Mn-crust, then 1-5 cm yellowish, soft material with small Mn-clasts (< 1 mm, 5 %), then up to 10 cm Mn-crust, then several cm of dk brown phosphate, then again the yellowish soft material enclosed by 5mm Mn crust							Y	

STATION 42. SAVAGE B
E side of volcanic ridge marking edge of plateau; southern site
Dredge on bottom UTC 27/12/02 1620hrs, lat 36°40.717'S, long 177°46.106'W, depth 3845m
Dredge off bottom UTC 27/12/02 1757hrs, lat 36°40.628'S, long 177°46.729'W, depth 3407m
20kg. Mainly Mn crusts with some sedimentary (and small highly altered lapilli) cores

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR42-1Mn	17x15x6cm	Dark brown Mn crust, no internal strcutures, 6cm thick.							Y	
DR42-2	8x7x4cm subrounded lump	?siliceous (noncalc) and tuffaceous grey sedimentary rock (cherty?). Appears brecciated, with minor 10-15m angular clasts of yellow-white highly altered olivine microphyric (<1%, 1mm) amygdaloidal (15%, 1mm) lava.						Y		4mm Mn rind and soft, pale brown silty material enclose rock
DR42-3	7x7x6cm rounded	grey ?siliceous (noncalc) cemented breccia in core of Mn nodule. Chert has clastic lithic & crystal grains. One 5mm piece red lapilli								
DR42-4	two pieces from 60x60x30cm block	yellowish soft fine grained siltstone with Mn crusts up to 1cm, containing highly vesicular palagonitised lapilli	Y			?				
DR42-5	6cm diameter round	Mn nodule core of highly vesicular palagonitised lapilli similar to DR42-4	Y			glass?				
DR42-6X	two pieces approx 20x20x15cm	similar to DR42-4				glass?	Y			
DR42-7X	block 20x20x12cm	similar to DR42-4				glass?	Y			

STATION 43. KIORE
NW side
Dredge on bottom UTC 28/12/02 0138hrs, lat 36°38.962'S, long 177°13.008'W, depth 4718m
Dredge off bottom UTC 28/12/02 0329hrs, lat 36°39.364'S, long 177°12.219'W, depth 4184m
40kg. Mainly quite fresh black-brown aphyric vesicular basalt. One small palag breccia piece, some detached Mn rinds

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR43-1	6x7x5cm subangular	dark grey vesicular (5%, <0.5mm, some larger elongate vesicles) aphyric basalt	Y	Y	Y					
DR43-2	25x20x20cm subangular	brown-black vesicular (30%, 1-2mm) aphyric basalt. Incipient coatings of clay & zeolite in vesicles	Y	Y				Y		Mn crust 1cm
DR43-3	6x4x3cm subangular	similar to DR43-2	Y							
DR43-4	6x4x3cm subangular	similar to DR43-2	Y							
DR43-5	7x5x3cm subangular	similar to DR43-2, vesicles generally <1mm	Y							Mn crust 7mm
DR43-6	5x4x2cm subrounded	yellow, red & brown palagonite breccia/lapilli tuff. Some holoxtalline lava clasts like DR2 to 5.	Y			glass?				Possible fresh(er) grey-black glass in parts of some lapilli
DR43-7	15x10x15cm broken from original 40x30x30cm subrounded	3cm clean Mn rind, on 4cm intergrown Mn & clay ring on lava							Y	
DR43-8X	10x10x7cm subrounded	lava like DR43-2 but slightly browner and with more vesicle fill					Y			
DR43-9X	25x20x20cm angular, sawn piece from DR43-7	brown coloured lava similar to DR43-2 that formed the core of the large Mn boulder (see DR43-7)								Mn rind sawn off this archive sample
DR43-10X	7x7x7cm angular	brown lava like DR43-2								
DR43-11X	19 individual pieces	lava like DR43-2								Bagged, but not numbered separately. These were separate pieces in the dredge.

STATION 44. RAPUHIA F
Rapuhia Scarp, SE Region, Nr 7 of Christmas mappimg, □H= 900 m over 1.2 nm
Dredge on bottom UTC 28/12/02 0906hrs, lat 37°07,527'S, long 177°07,864'W, depth 4976m
Dredge off bottom UTC 28/12/02 1034hrs, lat 37°07,993'S, long 177°08,423'W, depth 4280m
30kg. Mainly sedimentary rocks (sandstones, breccias), 5 small pieces of pumice, many Mn

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR44-1x	15x13x9 cm, subrounded	breccia, yellowish to dark brown volc and sed clasts. Poorly sorted (<1mm-2cm)						Y		3 mm Mn-crust
DR44-2x	12x12x6 cm, subrounded	light brown and subrounded breccia-conglomerate, 75% matrix (yellowish-white), 25% clasts (1mm-1.5cm)						Y		< 5 mm Mn-crust. Some clasts (3%) have alteration rim
DR44-3x	27x15x10 cm, sawn in 3 pieces, subangular	moderate yellowish brown fg & cg bedded sandstone, three 2 cm beds with different grain sizes						Y		thick (< 2 cm) Mn-crust. Some Mn crusting before deposition
DR44-4x	11x7x6 cm, subrounded	breccia, clasts are all light to dark brown 1-3 mm, subangular, some (5%) have an alteration rim								1 cm Mn-crust
DR44-5x	10x7x4 cm, subangular	dark red bedded mg-cg sandstone, coarser bed grains are subangular								
DR44-6x	5 pieces, 7x6x4 cm and smaller, subangular	5 pieces of pumice, colour white, > 50 % elongated bubbles, all subparallel, < 1 % small (< 1 mm), angular glass shards								
DR44-7x	18x17x7 cm, subrounded	breccia-conglomerate, clasts up to 4cm, and also have their own Mn-crust of 1 cm. Some clasts also consist of a breccia (3 mm clasts, light-dark-brown, subangular)								2 cm Mn-crust
DR44-8x	10x7x6 cm, subrounded	1-2cm bedded dark-yellowish-orange siltstone								< 1 mm Mn-crust
DR44-9x	11x8x5 cm, subrounded	siltstone, same as DR44-8x								< 2 mm Mn-crust
DR44-10x	14x6x3 cm, subangular	breccia, matrix (<30%) is yellowish-brown, clasts are orange and dark brown, subangular, <2 mm, some have a Mn-rim								
DR44-11x	20x15x5 cm, sawn in 2 pieces, subangular	breccia, same as DR44-10x						Y		< 4 mm Mn-crust
DR44-12x	16x13x10 cm, subangular	breccia, same as DR44-1x								thick (< 3 cm) Mn-crust
DR44-13x	13x9x8 cm, subrounded	breccia, same as DR44-1x								< 2 mm Mn-crust
DR44-14x	12x9x8 cm, subangular	breccia, same as DR44-1x								thick (< 4 cm) Mn-crust

STATION 45. RAPUHIA G
Steepest slope on plateau nose
Dredge on bottom UTC 28/12/02 1615hrs, lat 37º08.946'S, long 176º43.844'W, depth 5039m
Dredge off bottom UTC 28/12/02 1813hrs, lat 37º09.639'S, long 176º44.063'W, depth 4310m
20kg. Sedimentary rocks (sandstones, breccias) and Mn crusts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR45-1	20x20x10cm block	breccia. Clasts of lithified sedimentary rocks up to 3cm in yellowish fg matrix.						Y		Mn crusts on block and on clasts
DR45-2	18x15x9cm block	6cm thick Mn crust on breccia							Y	
DR45-3	14x9x5cm	5cm thick Mn crust							Y	
DR45-4	11x10x3cm	3cm thick Mn crust							Y	
DR45-5X	2 fragments, subrounded 10x6x3cm and 7x7x3cm	sandstone with 0.5cm Mn crusts								
DR45-6X	1 block 15x12x6cm	breccia similar to DR45-1								

STATION 46. PENGUIN A
Southeastern slope from base to top
Dredge on bottom UTC 29/12/02 1834hrs, lat 40º39.956'S, long 173º46.808'W, depth 2999m
Dredge off bottom UTC 29/12/02 1937hrs, lat 40º39.50'S, long 173º47.00'W, depth 2673m
5kg. Three Mn crusts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR46-1	2x1x1 cm	piece of lava from core of Mn crust, brownish very altered and replaced theough Mn						Y		
DR46-2	10x7x8 cm	piece of Mn crust, dark brown, subangular, bedded							Y	

STATION 47. PENGUIN B
Northeastern slope, bottom of small valley from base to top
Dredge on bottom UTC 29/12/02 2206hrs, lat 40º37.70'S, long 173º45.05'W, depth 3134m
Dredge off bottom UTC 29/12/02 2320hrs, lat 40º37.75'S, long 173º45.90'W, depth 2757m
30kg. Volcanic breccias with partly fresh vesicular olivine basalt clasts. Lots of Mn crusts.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR47-1	10cm clast removed from 40x30x20 cm block	ol-basalt clast from breccia, clasts highly vesicular and partly filled with zeolite	YY	Y	Y			Y		Mn crust up to 2cm thick, ol altered
DR47-2	8x7x3cm	basalt fragment similar to 1, in some areas partly fresh. Not as good as DR47-1								
DR47-3	3x3x5cm	basalt clast in lapilli tuff as described for DR47-5. Highly vesicular ol-basalt with partly relatively fresh matrix								
DR47-4	5x5x5 cm	basalt clast similar to DR47-3								
DR47-5	20x12x12 fragment from 60x60x30 Mn encrusted block	lapilli tuff consisting of highly vesicular to scoriaceous like palagonized lapilli and basalt fragments as described for DR47-3	YY							
DR47-6	12x7x5 cm	pumice fragment rounded and altered								
DR47-7	20x10x10 fragment from large block (see 5)	Mn crust 7cm thick							Y	
DR47-8	14x16x8 fragment from large block (see 5)	Mn crust 7cm thick							Y	
DR47-9	5cm diameter	Mn nodule							Y	
DR47-10	4cm diameter	Mn nodule							Y	
DR47-11X	25x18x12cm subrounded	lapilli tuff as described for 5								
DR47-12X	29 relatively small pieces from block (see 5)	all pieces contain rel. fresh vesicular ol -basalt clasts up to 5cm						Y		
DR47-13X	3 pieces (25x13x13cm, 15x15x12cm, 8x8x8cm) from large block described in DR47 -5	contain relative fresh basalt fragments and possibly lapilli with fresh glass				?				

STATION 48. POLAR BEAR A
Steep eastern flank
Dredge on bottom UTC 30/12/02 1007hrs, lat 41º31.18'S, long 173º57.08'W, depth 2504m
Dredge off bottom UTC 30/12/02 1140hrs, lat 41º30.77'S, long 173º57.98'W, depth 2082m
Empty dredge except for handful of soft sediment

STATION 49. POLAR BEAR B
Small canyon at western slope; steepest structure
Dredge on bottom UTC 30/12/02 1616hrs, lat 41º27.87'S, long 174º11.89'W, depth 2710m
Dredge off bottom UTC 30/12/02 1809hrs, lat 41º27.81'S, long 174º10.93'W, depth 2072m
200 kg. Fresh basalts with ol, px, plag & FeTiox phenos in various propns, some slighthy amygd, one piece of lst two congloms, a few Mn rinds

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR49-1	10x20x15cm subangular	basalt with grey fresh matrix, phenocrysts 1-5mm, oliv 15% (altered), px 5%, plag 2%, amygd 2%, some filled fractures	Y	Y	Y	px, fsp		Y		
DR49-2	15x15x15cm subangular	grey and brownish porphyritic basalt, oliv 10%, px 10%, plag 5%, amygd 1%. Orange altered olivine	Y	Y		px, fsp				
DR49-3	15x15x15cm subangular	porphyritic basalt, oliv 10%, px 10%, plag 5%, amygd 1%. Fresh grey in places brownish matrix, except for orange altered olivine	Y	Y		px, fsp		Y		
DR49-4	20x15x10cm subangular	brown to grey matrix (more altered than 1-3), porphyritic basalt Olivine 7%, Pyroxene 7%. Plagioclase 7%, altered orange olivines	Y	Y		px, fsp				
DR49-5	10x10x10cm subangular piece of columnar joint?	brownish grey porphyritic basalt, olivine 5%, Pyroxene 2%, Plagioclase 2%, traces of FeTi-Oxides, orange altered olivines	Y	Y		px, fsp, ilm				
DR49-6	15x10x10cm subangular	dark brownish grey porphyritic basalt, Olivine 3%, traces of px, plag 3%, amygd 1%, some epidote replacement of phenocrysts	Y	Y		px, fsp				
DR49-7	15x15x15cm subangular	grey porphyritic basalt, traces of oliv, plag 10%, cpx 1%, FeTi Oxides 1%. Some green white calcareous sediment veins penetrate sample	Y	Y	Y	px, fsp, ilm		Y		
DR49-8	10x5x4cm subangular	grey aphyric basalt weathering to brownish color on outside, weathering rind cut off for the geochemistry sample.	Y	Y	Y					
DR49-9	12x6x4 angular	greenish grey aphyric basalt. A few Mn dendrites growing in the rock. Thin alteration rind.	Y	Y						
DR49-10	0.5x0.4x0.3m angular boulder	brownish Mn spotted aphyric lava	Y							
DR49-11	0.4x0.3x0.3m angular boulder	brownish grey porphyritic basalt, oliv 10%, px 7%, plag 7%, amygd traces. Contains 3x2cm plag + FeTi-Oxide xenoliths (elongate) or glomerophyric cluster	YY	Y	Y?			Y		plag glomerophyric cluster or cumulate xenolith
DR49-12	20x15x10cm subangular	volcanic conglomerate, poorly sorted with 0.2-3cm subrounded clasts. Calcareous mudstone matrix in part, some pebbles are polished. Polymict red-green + grey volcanic clasts.						Y		good epiclastic conglomerate
DR49-13	20x15x5cm subrounded	similar to DR49-12								
DR49-14	10x10x10cm	grey tuffaceous partly silicified lst. Consists of (1) central part of hard grey ?bored or brecciated tuffaceous lst with (2) younger bed, boring or vein fill of hard yellowish foram lst.	Y					Y		not totally phosphatised
DR49-15X	from 0.3x0.2x0.3m subangular boulder	ol-px-plag basalt, brownish								
DR49-16X	from 0.3x0.2x0.2m subangular boulder	ol-px-plag basalt, brownish								
DR49-17X	7x7x4cm subangular	aphyric basalt								
DR49-18X	25x20x20cm subangular	sparsely porphyritic basalt								
DR49-19X	10x10x3cm subangular	sparsely porphyritic basalt								
DR49-20X	20x15x4 subrounded slab	Mn crust on lava							Y	
DR49-21X	5x5x5cm subangular	sparsely porphyritic basalt								
DR49-22X	15x10x10cm subrounded	moderately porphyritic basalt with whitish calcareous veins								
DR49-23X	20x20x15cm subrounded	moderately porphyritic basalt with 1cm Mn rind								
DR49-24X	20x15x10cm subangular	moderately porphyritic basalt with 0.5cm Mn rind								
DR49-25X	7x6x5cm subangular	moderately porphyritic basalt								
DR49-26X	7x6x5cm subangular	moderately porphyritic basalt								
DR49-27X	10x10x10cm subangular	strongly porphyritic basalt, large plagioclase								

STATION 50. POLAR BEAR C
Northwestern side, ca. 2.5nm north of DR49
Dredge on bottom UTC 30/12/02 2035hrs, lat 41º25.44'S, long 174º11.34'W, depth 2438m
Dredge off bottom UTC 30/12/02 2138hrs, lat 41º25.43'S, long 174º10.91'W, depth 2135m
4 kg, 10 rocks, sparsely olivine, cpx porphyritic basalts, possibly from same flow. Fairly fresh one piece with possible fresh glass rind, one piece of blue-grey clay.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR50-1	7x7x6cm angular	black basalt 1% olivine phenocrysts (1mm), traces of cpx	Y	Y	Y			Y		
DR50-2	4x3x4 cm angular	dark grey basalt vesicular (7%) with traces of clay in vesicles, trace olivine phenocrysts, maybe different from DR50-1	Y	Y	Y?					
DR50-3	20x20x10cm angular	brown basalt identical to DR50-1 but more altered (brown) and white/hard 2mm siliceous rind all with 3mm Mn crust on most surfaces	Y					Y		one broken non Mn covered surface
DR50-4	5x5x3cm subrounded	grey-yellow, red + green altered basalt. Also white siliceous rind like DR50-3.	Y							Sample for alteration studies
DR50-5	20x15x10 subrounded	brown basalt with Mn fractures penetratingsample. Similar to DR50-1								
DR50-6	6x5x4cm subangular	grey brown basalt like DR50-1. Possible fresh black glass in finer grained chilled rind of orange palagonite.	Y	Y?	Y?	glass				
DR50-7	10x5x3cm subangular	brown veined basalt like DR50-3								
DR50-8	5x5x4cm subangular	brown, veined basalt otherwise like DR50-3								
DR50-9	4x4x3 subangular	brown veined basalt like DR50-3								
DR50-10	4x3x3	similar to DR50-9								
DR50-11	6x4x3 rounded lump	pale bluish grey clay								

STATION 51. TV GRAB B
Top of Polar Bear
TV-grab over side UTC 30/12/02 2321hrs, lat 41°26.25'S, long 174°7.08'W, depth 1842m, cable 0m
TV-grab on bottom UTC 30/12/02 2348hrs, lat 41°26.36'S, long 174°7.05'W, depth 1840m, cable 1834m
TV-grab closed UTC 31/12/02 0020hrs, lat 41°26.12'S, long 174°7.05'W, depth 1849m, cable 1854m
TV-grab on deck UTC 31/12/02 0056hrs, lat 41°26.10'S, long 174°07.10'W, depth 1847m, cable 0m
Partly full of sediment. Single 4x3x2cm rounded piece white pumice: not kept. Pillow lavas, Mn nodules seen on TV camera

STATION 52. TV GRAB C
Top of Polar Bear
TV-grab over side UTC 31/12/02 0127hrs, lat 41°28.76'S, long 174°10.02'W, depth 1965m, cable 0m
TV-grab on bottom UTC 31/12/02 0202hrs, lat 41°28,736'S, long 174°09.97'W, depth 1957m, cable 1943m
TV-grab closed UTC 31/12/02 0212hrs, lat 41°28.04'S, long 174°09.99'W, depth 1959m, cable 1968m
TV-grab on deck UTC 31/12/02 0255hrs, lat 41°28.10'S, long 174°09.98'W, depth 1958m, cable 0m
Full, sediment only

STATION 53. BOX CORER B
Top of Polar Bear
box corer over side UTC 31/12/02 0310hrs, lat 41°28.07'S, long 174°09.99'W, depth 1958m
box corer on bottom UTC 31/12/02 0354hrs, lat 41°28.11'S, long 174°09.97'W, depth 1957m
box corer on deck UTC 31/12/02 0428hrs, lat 41°28.11'S, long 174°09.98'W, depth 1957m
Full, sediment only

STATION 54. WISHBONE A
NE end of surveyed part
Dredge on bottom UTC 01/01/03 0053hrs, lat 40°38.53'S, long 169°44.34'W, depth 3750m
Dredge off bottom UTC 01/01/03 0236hrs, lat 40°38.05'S, long 169°44.96'W, depth 3030m
12kg. Coarse-fine grained sst & siltst, some as Mn-cemented breccia clasts, some as individual Mn-coated pieces

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR54-1	7x5x4 cm, subang	Mn-coated cg sandstone clast from DR54-2. Light greenish gray (5 GY 8/1) coarse grained sst, mod. hard with estimated quartz (15%), fsp.(15%), red, gray and yellow lithics (70%). Some white minerals + hbl (?)	Y					Y		cannot tell if volcanic lithics are from local seamount or elsewhere
DR54-2	15x10x5 cm	Mn-cemented breccia, polymict clasts of pale gray brown sandstone + siltstone, like other rocks in the dredge. Grainsize of clasts 5-50 mm. DR54-1 is a clast of DR54-2						Y		5 mm Mn-crust
DR54-3	20x15x5 cm subrounded	pale grey-brown medium sandstone, similar in compare to DR54-1						Y		weathering rind / front is cut by 7mm Mn-rind; indicates exposure to seafloor before brecciation
DR54-4	12x10x5 cm, subrounded	mod. yellowish brown (10 YR 5/4), Mn penetrated, med grained sandstone						Y		5 mm Mn-crust
DR54-5	10x8x3 cm, subrounded	light olive grey (5 Y 5/2), finegrained sandsone similar to DR54-1						Y		2 mm Mn-crust
DR54-6x	15x8x12 cm, subrounded	fractured and Mn-veined fine grained sandstone similar to DR54-1								10 mm Mn-crust
DR54-7x	15x10x5 cm subangular	Mn-cemented polymict sed. Conglomerate like DR54-2, sandstone / mudstone clasts (0.5-5 cm in size)						Y		8 mm Mn-crust
DR54-8	5x5x5 cm subangular	Mn-penetrated very fine grained sandstone otherwise similar to DR54-2						Y		
DR54-9	7x5x4 cm, subang.,	cm-bedded fine grained sandstone or siltstone, bedding parallel to long axis of small slab						Y		2 mm Mn-crust
DR54-10x	8x6x3 cm subangular	similar to DR54-9 but bedding crosses short axis								8 mm Mn-crust with siliceous bands
DR54-11x	6x3x3 cm subangular	Mn-penetrated and soft light olive grey (5 Y 5/2) siltstone, probably part of the same sedimentory suite as the sandstones.						Y		5 mm Mn-crust
DR54-12x	6x4x3 cm subangular	sim. to DR54-11x								5 mm Mn-crust
DR54-13x	5x4x3 cm	broken fine grained sandstone to siltstone, mostly Mn-crust								1 cm Mn-crust
DR 54-14Mn	10x10x4 cm	Mn nodule, no apparent core							Mn	

STATION 55. WISHBONE B
Southern part of ridge, upper part of SE slope
Dredge on bottom UTC 01/01/03 0533hrs, lat 40°45.16'S, long 169°49.68'W, depth 3300m
Dredge off bottom UTC 01/01/03 0723hrs, lat 40°44.94'S, long 169°50.05'W, depth 2567m posn before dredge got struck
20kg. One large sandstone boulder, some feldspar rich volcanic rocks (dacitic?)

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR55-1	20x15x10 cm, subangular	light grey porphyritic ?dacitic lava with abundant (<5mm) Mn-spots and small through-going Mn-coated fractures. 10-15 % feldspar phenocrysts, possibly two feldspars (plag & kspar), <1% altd amphibole? phenocrysts as only mafic phase.	Y	Y	Y			Y		thin (< 2 mm) Mn-crust. Mn cut off and fresh inner core separated for geochem. Extra bag of sample for mineral separation
DR55-2	7x5x5 cm	same as DR55-1								
DR55-3	5x4x5 cm	same as DR55-1								
DR55-4	40x30x30 cm rounded boulder	coarse grained green-olive pebbly sandstone, no Mn-crust, size of the clasts 1-8 mm (average 2-3 mm). Clasts are mainly volcanics. Including pumiceous/scoriaceous material	Y		Y			Y		Check TS to see if sample contains datable mineral phases e.g. biotite, amphibole

STATION 56. WISHBONE C
Southern part of ridge, entire height of SE slope c. 1 mile SW of DR55
Dredge on bottom UTC 01/01/03 0957hrs, lat 40º45.89'S, long 169º50.57'W, depth 3548m
Dredge off bottom UTC 01/01/03 1132hrs, lat 40º45.39'S, long 169º50.70'W, depth 2752m
50kg. Grey and red feldspar porphyritic dacitic lavas and ?shallow granitic intrusives, some cataclastic

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR56-1	20x15x12 cm subrounded	light grey porphyritic ?dacitic lava, partly fresh matrix. 10-15% feldspar phenocrysts (1-7mm, possibly two 2 types, milky kspar and clear plag)	Y	Y	Y	Y		Y		possible candidate for zircon dating. No Mn-crust
DR56-2	25x15x7 cm platy, subangular	pale grey fsp and ?quartz porphryritic ?rhyolite. rock, 20% phenos, mainly feldspars (kspar 5%, plag 12%?), poss 3% smoky quartz. 3% unfilled vesicles <1mm	Y	Y	Y	Y		Y		dacitic or rhyolitic? A tuff? No Mn-crust. Slickensides on one side of sample
DR56-3	25x13x16 cm, subangular	greyish-green plagioclase pptic (15%) dacitic lava, no milky fsp. Matrix is dissected by numerous fractures along which it is altered to yellowish material	Y	Y	Y	Y		Y		no Mn-crust
DR56-4	30x18x15 cm subangular boulder	brown-reddish matrix altered dacite with 10% plagioclase phenocrysts (1-3 mm)	Y	Y				Y		large block for chem. No Mn-crust,
DR56-5	7x7x9 cm, subangular	cataclasite, fragments are angular, 2-5 cm in diameter dacite clasts						Y		no Mn-crust
DR56-6	10x8x4 cm, subangular	porphyritic dacite 10-15 % plagioclase up to 5 mm, orange alteration along parallel fractures						Y		
DR56-7	30x20x15 cm angular	fault breccia with large angular clasts								
DR56-8	10x8x8 cm subangular	volcanic rock, similar to DR56-2, but more porphyritic (~30%), kspar and plagioclase phenocrysts	Y							Subvolcanic rock?
DR56-9	two pieces	platy volcanic rock with slickensides on both sides.								Documents presence of fault zone.
DR56-10	8x8x8 cm	highly porphyritic rock, two holocrystalline fsp (ksp and plag), 3% dark minerals (amphibole?)								hypabyssal rock?
DR56-11x	8x5x3 cm subangular	fragment, similar to DR56-2, but more phenocrysts (~25%)					Y			
DR56-12x	15x8x8 cm subangular	volcanic rock, similar to DR56-3					Y			
DR56-13x	subangular	12 boulders of porphyritic volcanics, representative to this dredge, keep for backup					Y			

STATION 57. CHICKEN-HUENCHEN
Eastern slope
Dredge on bottom UTC 01/01/03 1742hrs, lat 41º03.44'S, long 169º05.34'W, depth 2796m
Dredge off bottom UTC 01/01/03 1900hrs, lat 41º03.49'S, long 169º05.94'W, depth 2350m
100kg. Mostly highly altered aphyric ?basalts or hawaiites, some fresher plagioclase porphyritic ?dacites, volcanic breccias

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR57-1	20x15x10 cm, subrounded, cut in 3 pieces	greyish brown plag pptic (10% 5mm) basalt	Y	Y	Y	fsp		Y		Altered, but freshest of the dredge.
DR57-2	10x8x7 cm subrounded	greyish brown plag pptic (10%) basalt.	Y	Y		fsp				very thin (< 1 mm) Mn-crust. Bit more altered than DR57-1
DR57-3	16x16x5 cm subangular, flat, platy	olive grey plag pptic (10%) basalt lava,				fsp				thick alteration rind (<2cm). Most altered of DR57-1 to -3
DR57-4	8cm clast from breccia 10x10x5 cm subangular	altered basaltic clast with fresh interior. Volcanic breccia is light grey, greenish-brown, poorly sorted, angular clasts <1cm	Y	Y						< 3 mm Mn-crust
DR57-5 (a-d)	25x25x20 cm boulder, subrounded, hammered into many pieces, put in 4 bags (a-d),	green, grey, brown aphyric lava with subtrachytic fg groundmass of 40% fsp. Strong, multicolour clay alteration along parallel fractures	YY Y					Y		TS of three different pieces for alteration studies
DR57-6	8x6x5 cm subangular	aphyric lava trachyandesite? Jointed matrix is greyish brown, one less altered part (matrix grey)	Y							< 1 mm Mn-crust
DR57-7	9x8x7 cm, subrounded	grey brown, aphyric basalt-hawaiite? strongly altered, jointed						Y		
DR57-8x	15x10x10 cm angular	aphyric lava, matrix greyish-yellow brown, with small Mn-concretions, 2cm dark brown alteration rind					Y			
DR57-9x	10x8x4 cm subangular	same as DR57-8x					Y			
DR57-10x	7x7x4 cm, subangular	same as DR57-8x					Y			< 1 cm Mn-crust
DR57-11	20x12x5 cm subrounded	volcanic breccia, subang-subrounded poorly sorted. Clasts black, dark green, dark brown. One big clast (2.5cm) shows 15% greyish phenocrysts, which are strongly altered (< 4 mm)	Y					Y		< 2 mm Mn-crust
DR57-12	10x8x7 cm subangular	grey-brown volcanic breccia. Clasts angular-subangular, consist of strongly altered lava	Y					Y		
DR57-13	10x10x8 cm subrounded	pale orange phosphatised limestone nodule with 8 % volcanic sand grains and clasts up to 1cm. Weak reaction with HCl. Contains burrows (<1%, 1cm)						Y		no crust
DR57-14Mn	15x12x10 cm subangular	4 cm thick Mn-crust on a volcanic (?) breccia							Y	

STATION 58. PUKEKO
Northeastern Corner, east facing slope
Dredge on bottom UTC 02/01/03 0403hrs, lat 41º43.84'S, long 169º17.18'W, depth 3710m
Dredge off bottom UTC 02/01/03 0553hrs, lat 41º43.99'S, long 169º16.99'W, depth 3127m
500kg. Subangular boulders of moderately platy, non- to slightly vesicular aphyric ?trachytic lava

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR58-1	30x17x10cm subangular	pale grey fresh aphyric lava with open vesicles (5%, 0.1-0.5cm). Many vesicles are elongated parallel to platy joints.	Y	Y	Y			Y		this rock appears more differentiated than a basalt. Basaltic andesite?
DR58-2	15x15x15cm subangular	pale grey aphyric lava. Outer 3cm rim contains abundant Mn spots. Thin <0.1mm Mn film	Y	Y	Y					cut off on geochemistry sample. Could be an intermediate composition like DR58-1.
DR58-3	12x8x10cm subrounded	grey to light brown aphyric lava, slightly more altered than DR58-1 and 2. Vesicles 2-3%, 0.2 cm in diameter, some with Mn coatings and cm Mn spots on outside.	Y					Y		similar to DR58-1.
DR58-4	14x17x10cm subrounded	pale grey to greenish aphyric lava with vesicles (2-3%, 0.1-0.5 cm). Joints spaced every 0.5cm, some joints and vesicles have Mn coatings.	Y							similar to DR58-1.Mn spots on the outside.
DR58-5	20x20x12cm subangular	similar to DR58-4 but slightly more altered	Y							
DR58-6	10x8x8cm subrounded	basalt clast. Mn spots on the outside. Light grey fresh matrix, aphyric. Inner core is dense whereas outer 1-2 cm are 2% vesicular. Petrographically a combination of DR58-1 and DR58-2	Y							
DR58-7	6x10x15cm subangular	lava similar to DR58-4 and 58-5 but the most altered in this category. Brownish green matrix, 4% elongated vesicles that are mostly covered with Mn.	Y							
DR58-8	8x13x10cm subangular	Greyish-green lava dense aphyric similar to DR58-2. However this lava contains abundant basaltic "xenoliths" (lithic fragments).	Y							Spotty Mn on outside. Lithics are vesicular, subrounded and probably stem from the degassed top of the underlying flow.
DR58-9	18x18x13cm subangular	lava, similar to DR58-8 but contains bigger basaltic lithics up to 6cm in diameter	Y							
DR58-10	15x18x18cm subrounded	lava similar to DR58-4 but contains small (up to 1cm) rounded basaltic lithics. Lithics have 5% vesicles up to 1mm in diameter	Y							4mm Mn crust on the outside, thickest Mn crust in this dredge.
DR58-11	20x10x5cm angular	monomict breccia containing greenish-grey altered angular basalt clasts. Basalt clasts similar to DR58-7	Y					Y		
DR58-12	15x6x10cm angular	breccia with yellow matrix. Clasts are mainly subangular dense aphyric basalt, 1-4cm in diameter.	Y					Y		
DR58-13	5x5x5cm rounded	clast of brownish-red volcanic breccia, containing highly vesicular basalt clasts with 25% vesicles, round 0.5-2 mm diameter	Y							
DR58-14X		similar to DR58-2 but abundant Mn veins					Y			
DR58-15X		similar to DR58-4					Y			
DR58-16X		similar to DR58-3					Y			
DR58-17X		similar to DR58-3					Y			
DR58-18X		similar to DR58-3 throughDR58-10					Y			
DR58-19X		similar to DR58-3 throughDR58-10					Y			
DR58-20X		similar to DR58-3 throughDR58-10					Y			
DR58-21X		similar to DR58-3 throughDR58-10					Y			
DR58-22X		8 clasts similar to DR58-12					Y			
DR58-23X		breccia with strongly altered basalt clasts					Y			
DR58-24X	30x40x20cm	basalt boulder with calcite cemented basalt breccia on one side					Y			
DR58-25X		basalt breccia with 10cm sized angular clasts					Y			
DR58-26X	20x20x20cm	altered basalt with yellowish (secondary) breccia on one side					Y			

STATION 59. WETA A
Northeastward facing slope of biggest WETA seamount
Dredge on bottom UTC 02/01/03 1426hrs, lat 42º11.93'S, long 168º50.90'W, depth 2907m
Dredge off bottom UTC 02/01/03 1540hrs, lat 42º12.42'S, long 168º51.16'W, depth 2436m
10kg. Three boulders of mod fresh vesicular olivine basalt one piece with thick Mn crust

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR59-1	13x13x10cm subangular	brownish-grey olivine pptic (10%) basalt. 15% round to oval vesicles, 50% filled with soft brown mud	Y	Y	Y			Y		Initial description "No recognizable phenocrysts, 10% orange spots are most likely Fe hydroxides"
DR59-2	12x15x15cm round	Mn encrusted lava similar to DR59-1. Small 5x10x7cm without Mn crust kept for petrology, rest to Mn group							Y	Mn crust 5cm thick, laminated.
DR59-3	10x6x6cm round pebble	basalt, similar to DR59-1.								

STATION 60. WETA B
Another biggish cone 4 miles SSW
Dredge on bottom UTC 02/01/03 1807hrs, lat 42º15.51'S, long 168º52.47'W depth 2855m
Dredge off bottom UTC 02/01/03 1853hrs, lat 42º15.71'S, long 168º53.01'W, depth 2570m
7kg. One boulder of very Mn-altered and crusted volcanic breccia, matrix is phosphatised limestone with forams

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR60-1	35x25x15 cm subangular, hammered in small pieces (1x normal sample, 3x for archive, 1x for Mn, 1x for GNS)	volcanic breccia, clasts (>50%) are poorly sorted (<1mm - 4 cm), subangular, consist of strongly Mn-altered amygdaloidal basaltic material	Y					Y	Y	breccia matrix is yellowish-white, non-calc rock with forams (3%, < 1 mm), prob phosphatised limestone. Mn-crust <4cm, cracks in breccia are filled with Mn-oxide

STATION 61. KAKAPO A
Western seamount flank
Dredge on bottom UTC 03/01/03 0624hrs, lat 43º28.44'S, long 168º37.35'W depth 3174m
Dredge off bottom UTC 03/01/03 0731hrs, lat 43º28.29'S, long 168º36.16'W, depth 2755m
0.5kg. Two small Mn nodules, one with 3mm lava fragments in core

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR61-1	5x7x5cm round	Mn nodules, 2-3cm thick with laminated Mn layers. Core consists of small rounded, 3mm basalt clasts, yellowish material and whitish hard phosphorite.							Y	
DR61-2		similar to DR61-1							Y	

STATION 62. TAKAHE
Across nose of northwestern plateau margin
Dredge on bottom UTC 03/01/03 1259hrs, lat 43º03.87'S, long 168º45.60W, depth 3102m
Dredge off bottom UTC 03/01/03 1425hrs, lat 43º03.56'S, long 168º44.87'W, depth 2441m
half dozen blocks up to 1.5m, Mn-crusted volcanic-hypabyssal dacitic-granitic rocks, some cataclastic; 1 piece clean pumice

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR62-1	70x50x30cm angular	light grey (N7) hypabyssal feldspar porphyry of prob dacitic-granitic composition. Phenos 30-40% fsp (plag and ?Kspar to 8mm), 5% chloritised mafic phenos (hbl?). Microcrystalline siliceous matrix. 1-2% round equigran hb microdiorite xenoliths up to 1cm.	Y	Y	Y	fsp zc		Y		DR62 rocks very hard to saw. Possible zc dating. Some Mn nucleation within sample; DR62-1 is freshest and cleanest of the set for geochem; also has the finest grained groundmass. 1-2 % open holes with vuggy quartz: poss result of weathering. 2-3cm Mn rind
DR62-2AB	60x50x50cm subangular	two rock types A: greyish orange pink (5YR7/2) fsp pptic (60%) hb (altd 5%) granite-granodiorite. B: dusky yellowish brown (10YR2/2) fg equigran hb (needle-like, altd) diorite prob occurs as cognate xenolith in A.	YY Y	YY	Y	fsp zc		YY		DR62-2A broadly similar to DR62-1 but groundmass is distinctly coarsest of the dredge so it has plutonic rock name. Pptic granite is locally mylonitic, both rock types cut by epidotised microfaults spaced a few cm apart; some slickensides. 2-3cm Mn rind
DR62-3AB	50x40x15cm angular	composite like DR62-2 A: light grey (N7) fsp porphyritic dacite/granite w 5% altd mafics B: medium grey (N5) fg equigranular hb (5%, altd) diorite, prob as xenolith	Y	Y	Y	fsp zc		YY		DR62-3A groundmass coarser than DR62-1, finer than DR62-2A. 2-3cm Mn rind
DR62-4	20x10x10cm angular	similar to DR62-1 but more microcracks	Y							2-3cm Mn rind
DR62-5	two 20x10x10 rounded	clean, white pumice lumps	Y					Y		prob from NZ TVZ.
DR62-6	5x7x6cm rounded	Mn crusts up to 6cm thick growing on boulder							Y	
DR62-7	1.2x0.8x0.8m angular boulder	cataclastic, locally mylonitic fsp porphyry, essentially simialr in grain size & mineralogy to DR62-4	Y					Y		8cm Mn rind. Less suitable for geochem than the other samples.
DR62-8	about 50g granules	silica/phos/zeolite coated & cemented rounded rock fragments, that have accumulated in a crack in DR62-7	Y					Y		TS to identify rock types in the area of the dredge

STATION 63. KAKAPO B
SE slope
Dredge on bottom UTC 03/01/03 1916hrs, lat 43º29.67'S, long 168º32.51W, depth 3221 m
Dredge off bottom UTC 03/01/03 2037hrs, lat 43º29.42'S, long 168º33.17'W, depth 2830m
volcanic breccia with analysable (just) plag basalt clasts, Mn-crust

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR63-1	25x20x10 cm subrounded	hard cemented volcanic breccia, clasts 0.3-1.5 cm. Brown, plagioclase-phyric (10 %, 6 mm), basaltic lava clasts; breccia matrix is grey (phosphatized?), also quite sandy with volcanic grains	Y		Y	fsp		Y		separate plag for Ar dating
DR63-2	small lava clast sawn from DR63-1	hard, moderate brown (5YR4/4) plag-porphyritic (up to 4 mm; 10-20%) ?basalt		Y						only for geochem
DR63-3	small lava clast sawn from DR63-1	similar to DR63-2		Y						only for geochem
DR63-4	small lava clast sawn from DR63-1	similar to DR63-2		Y						only for geochem
DR63-5Mn	10x6x5 cm subrounded	1 piece of Mn-crust (6 cm thick)							Y	

STATION 64. KIEL
Rift on eastern slope towards plateau
Dredge on bottom UTC 04/01/03 0211hrs, lat 43º40.64'S, long 168º12.79W, depth 3778 m
Dredge off bottom UTC 04/01/03 0439hrs, lat 43º41.15'S, long 168º13.95'W, depth 3411m
Empty dredge

STATION 65. HAMBURG
NW ridge on main S top
Dredge on bottom UTC 04/01/03 1615hrs, lat 44º31.15'S, long 170º02.39W, depth 3798m
Dredge off bottom UTC 04/01/03 1757hrs, lat 44º31.70'S, long 170º02.51'W, depth 3271m
30kg. Single Mn block with small amygdaloidal lava & phosphorite nodule corestones

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR65-1	2x1x1cm piece sawn from 60x30x20cm subangular block (applies to all samples in DR65)	dark brown, mod hard, plag (5% fresh, 3mm) + oliv (alt, 1%, 1mm)-phyric amygd (40-55%, 1mm, phosphorite) basalt			Y	fsp				
DR65-2	sawn 5x1x1cm piece, subangular	same as DR 65-1			Y	fsp				
DR65-3	sawn 2x2x1cm piece, subangular	same as DR 65-1			Y	fsp				
DR65-4	sawn 2x1x1cm piece, subangular	same as DR 65-1	Y							typical of the small separate lava pieces
DR65-5	sawn 2x1x1cm piece, broken, subangular	same as DR65-1		Y						possibly the best sample for geochem (pick matrix)
DR65-6	sawn 2x2x1cm piece, subangular	same as DR 65-1								least attractive of all the lava pieces, use last
DR65-7	8x8x10cm from main part of slab	Mn nodule, with variety of separate 0.3-2cm subang-subrounded corestones, all Mn-supported.	Y							TS is of 2-3 amygdaloidal lapilli, similar to lavas DR65-1 to 6
DR65-8	sawn slab of 8x6x3 cm	irregular, cream yellow sculpted, subrounded phosphorite nodule, entirely Mn-crusted, from the main slab								
DR65-9	5cm thick	5 cm exterior Mn rind with interior rock pieces, sawn from the big block							Y	
DR65-10	5x1x1cm	olivine and pyroxene amygdaloidal lava, similar to DR65-1, within main slab, surrounded by Mn						Y		
DR65-11	6x3x1cm	cream-yellow phosphatized limestone nodule, entirely surrounded by Mn						Y		
DR65-12x	20x10x10cm angular	1 piece of the 60x30x20 slab, keep as a general piece.					Y			No interesting rocks visible
DR65-13	sawn 5x5x3cm	hard grey phosphatized limestone, a separate nodule within Mn-slab						Y		

STATION 66. ERIK
South eastern slope just below plateau
Dredge on bottom UTC 05/01/03 0817hrs, lat 44º45.60'S, long 172º05.59'W, depth 2926m
Dredge off bottom UTC 05/01/03 0924hrs, lat 44º45.24'S, long 172º05.83'W, depth 2534m
2kg. A few sparsely plag-phyric basalt pieces (one very fresh) + 1 phosphorite nodule

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR66-1	15x15x15cm subangular	dark grey to light green plagioclase phyric (3%, 3mm) basalt. Nonvesicular in the center, outer 2cm has open vesicles <0.5mm.	Y	Y	Y	fsp		Y		
DR66-2	5x5x5cm subrounded	light grey plagioclase-phyric (2-3%) basalt, nonvesicular.	Y	Y?	Y?					Fairly similar to DR66-1.
DR66-3	9x7x4 subangular	strongly (chlorite) altered green plag-phyric (1-2%, 2mm) basalt	Y	Y?	Y?					
DR66-4	7x6x6 rounded	Phosphorite nodule. Red brown inner core 3cm in diameter. Transition to yellowish-green dense rim material.						Y		Does not fizz with HCl.
DR66-5	4x4x4 angular	brown strongly altered plag-phyric (2-3%, 3mm) basalt clast, nonvesicular								Similar to DR66-1 but strongly altered.
DR66-6	3x2x3 angular	similar to DR66-5								

STATION 67. FRANKFURT
Eastern slope, upper base
Dredge on bottom UTC 05/01/03 1830hrs, lat 45º37.37'S, long 172º35.63'W, depth 4030m
Dredge off bottom UTC 05/01/03 1949hrs, lat 45º36.94'S, long 172º36.22'W, depth 3560m
50 kg. ~80 pieces <30 cm. Two types of lava: aphyric, highly vesicular and porphyritic with less vesicles

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR67-1	20x15x7 cm subrounded	dusky yellowish brown (10YR2/2) porphyritic (20%, 7mm), vesicular (5%, 2mm) basaltic lava. Phenocrysts either feldspar and/or feldspathoid.	Y	Y	Y	fsp neph		Y		Confirm possible feldspathoid phenocrysts
DR67-2	14x12x8 cm subangular	dusky yellowish brown (10YR2/2) aphyric vesicular basaltic lava with 1mm rim of brownish palagonite and/or glass. Mn-crust <1mm.	Y	Y	Y	glass		Y		Vesicles big (5%, 2 cm) and small (10%, 1mm), partly filled with second. min. Some Mn-filled veins
DR67-3	12x10x7 cm, subangular	moderate brown (5YR4/4), feldspar- or foid-phyric (7%, <3mm), amygdaloidal (5%, <1mm, yellowish material) basaltic lava.	Y	Y	Y			Y		
DR67-4	8x6x4 cm subangular	dusky yellowish brown (10YR2/2) aphyric vesicular basaltic lava, alteration rind (brown, 6mm, palagonite?)	Y	Y	Y			Y		Two types of vesicles: big (2%, 4mm) and small (5%, 1mm)
DR67-5	10x4x4 cm subangular	basaltic lava, matrix dusky brown (5YR2/2), aphyric, 2 types of vesicles: big (< 1%, 3 mm) and small (7%, << 1mm)								
DR67-6	7x7x4 cm, subangular	similar to DR67-5 except for vesicle sizes								
DR67-7	12x5x5 cm, subangular	similar to DR67-5 except for vesicle sizes								
DR67-8	8x8x8 cm, subangular	similar to DR67-5 except for vesicle sizes								
DR67-9Mn	five rocks, diameter ~6 cm, rounded	Mn-nodules							Y	
DR67-10Mn	10x10x10 cm	Mn-crust							Y	
DR67-11	10x7x4 cm, subrounded	moderate yellowish brown (10YR5/4) phosphorite nodule								< 2 mm Mn-crust
DR67-12x	14x10x7 cm, subangular	greyish brown (5YR3/2) plag or foid-phyric basaltic lava. 25% milky-white phenocrysts (foids?), partly altered. 5% vesicles (1 mm. filled)					Y			
DR67-13x	15x10x8 cm, subangular	same as DR67-1, a bit more altered					Y			
DR67-14x	9x6x4 cm	same as DR67-1, strongly altered					Y			
DR67-15x	20x8x7 cm	same as DR67-1, strongly altered					Y			
DR67-16x	20x16x11 cm subroounded	same as DR67-1					Y			
DR67-17x	13x7x4 cm + smaller	5 pieces, same as DR67-1					Y			
DR67-18x	8x5x5 cm	basaltic lava, perhaps part of a pillow. Similar to DR67-5, but strongly altered orange rind					Y			
DR67-19x	8x6x5 cm	same as DR67-18x					Y			
DR67-20x		same as DR67-19x					Y			
DR67-21x	8x5x4 cm, subangular, 2 pieces	basaltic lava, matrix moderate brown, same as DR67-3					Y			<< 1 mm Mn-crust

STATION 68. STUTTGART
Top
TV-grab over side UTC 6/1/03 0140hrs, lat 45º29.368'S, long 173º22.568'W, depth 3940m, cable 0m
TV-grab on bottom UTC 6/1/03 0245hrs, lat 45º29.349'S, long 173º22.690'W, depth 3946m, cable 3927m
TV-grab closed UTC 6/1/03 0318hrs, lat 45º29.290'S, long 173º22.744'W, depth 3951m, cable 3956m
TV-grab on deck UTC 6/1/03 0440hrs, lat 45º29.326'S, long 173º22.748'W, depth 3947m, cable 0m
Full, sediment with macrofauna, no rocks

STATION 69. STUTTGART
Top
box corer over side UTC 6/1/03 0504hrs, lat 45º29.300'S, long 173º22.738'W, depth 3948m, cable 0m
box corer on bottom UTC 6/1/03 0620hrs, lat 45º29.309'S, long 173º22.722'W, depth 3951m, cable 3948m
box corer on deck UTC 6/1/03 0725hrs, lat 45º29.223'S, long 173º22.392'W, depth 3941m, cable 0m
Empty, did not operate properly

STATION 70. STUTTGART A
Southeastern slope
Dredge on bottom UTC 06/01/03 0939hrs, lat 45º29.32'S, long 173º14.20'W, depth 4591m
Dredge off bottom UTC 06/01/03 1107hrs, lat 45º28.95'S, long 173º14.55'W, depth 3956m
Empty dredge

STATION 71. STUTTGART B
Southeastern corner, upper slope
Dredge on bottom UTC 06/01/03 1352hrs, lat 45º29.57'S, long 173º15.64'W, depth 4240m
Dredge off bottom UTC 06/01/03 1506hrs, lat 45º29.07'S, long 173º15.71'W, depth 3654m
20kg. Greenish-grey schists, some phosphorite and Mn nodules

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR71-01	17x14x8 cm, angular	dark greenish grey qtz-feldspar-chlorite-muscovite schist. 3-4% feldspathic or lithic "augen" appear rotated. Quartz segregations parallel to schistosity.	Y	Y	Y	mica		Y		Resembles greenschist facies textural zone 4 schist from Caples Terrane, Otago
DR71-02	20x20x15cm angular	dark greenish grey qtz-feldspar-chlorite-muscovite schist. Perhaps more micaceous than DR71-01. Reddish mineral (possible garnet) on foliation surfaces.	Y	Y	Y	mica		Y		
DR71-03	40x30x20cm angular	moderate greenish grey schist, more fissile and finer grained than DR71-01 and 02.	Y					Y		1cm Mn crust. Either a lower rgade schist than DR71-1 and 2, or an ultramylonite
DR71-04	Five 8x8x5cm subangular pieces	tectonic-sedimentary breccia. Angular schist fragments are set in a matrix of hard, clean light orange brown ? siliciceous or phosphatic mudstone. Possible replaced limestone.						Y		Does not fiyy with acid. No sign of bedding planes in material. Also forms vein infillings on other schist samples.
DR71-05	Three round 5cm nodules	Mn nodules							Y	
DR71-06X	10x10x10cm angular	greenish mica schist								
DR71-07	10x6x5cm angular	similar to DR71-1						Y		
DR71-08	8x7x5cm subrounded	noncalc, pale yellow softish phosphorite nodule						Y		
DR71-09	10 pieces of schist, ang-subang, 5-10cm in size	Mix of hammered pieces from DR71-1 to 3 and smaller individual pieces						Y		<2mm Mn rinds. All pieces to GNS

STATION 72 MÜNCHEN
Valley at upper eastern slope
Dredge on bottom UTC 07/01/03 0025hrs?, lat 44º42.86'S, long 174º02.80'W, depth 2286m
Dredge off bottom UTC 07/01/03 0127hrs, lat 44º42.99'S, long 174º03.60'W, depth 1979m
1000kg. Mostly mod well sorted volcanic breccia/lapilli tuff incl. palagonite, a few vesic plag pptic lavas as bombs & clasts, Mn-crusts, phosphate nodules
additional comment: three dropstones 1 quartzite + 1 gneiss (not kept), possibility of DR72-1 being a dropstone too

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR72-1	10x7x6cm subrounded	moderate brown (5YR3/4) plagioclase pptic (10%, 3mm) basalt. 10% vesicles (1mm). Trace cpx phenos.	Y	Y	Y	fsp		Y		Sample was separate from breccias, a small possibility it is a dropstone. Thin (<< 1mm) Mn-crust
DR72-2	4x3x2 cm, subrounded piece extracted from DR72-5	mod. brown (5YR3/4) to dark yellowish brown in the middle plag pptic (7%) basalt. Vesicles 15%, <<1mm in middle; 5%, <2mm and aligned circumferentially in outer part: indicates sample is a volcanic bomb.	Y	Y	Y	fsp				Definitely a local eruptive (bomb)
DR72-3	12x12x10 cm subrounded	greyish to moderate yellow (5Y8/4), to partly orange volcanic breccia. Scoriaceous clasts mod. sorted, with graded bedding visible. Some clasts strongly palagonised orange colour.	Y		Y	fsp		Y		possibility of Ar dating individual detrital plag grains
DR72-4	10x9x6 cm subrounded	breccia, clasts poorly sorted (1 mm - 2 cm), colour is a moderate greenish yellow (10Y7/4), no palagonite clasts								
DR72-5	20x18x10 cm subrounded	1 piece of breccia, contained bomb DR72-2, similar to DR72-3								
DR72-6	17x11x10 cm, subrounded	graded bedding, sim. to DR72-3								
DR72-7	10x8x6 cm	breccia, sim. to 72-4								
DR72-8Mn	12x12x7 cm	Mn-crust, enclosing volc. breccia, veins filled with Mn + phosphate							Y	
DR72-9	10x10x2 cm + smaller	3 pieces of phosphorite beds, partly with Mn-crust (<< 1 mm)						Y		
DR72-10	12x11x9 cm, subangular	phosphorite nodule, veins filled with phosphated limestone (?), internally brecciated material						Y		
DR72-11	8x8x7 cm, subrounded	breccia, sim. to DR72-4								
DR72-12x	14x14xx16 cm	phosphorite nodule						Y		
DR72-13x	18x18x15 cm	breccia, sim. to 72-3								
DR72-14x	~ 10 pieces	similar material to DR72-4								

STATION 73. WESTERN UPRISING
Northeastern shallow slope
Dredge on bottom UTC 07/01/03 0704hrs, lat 44º12.99'S, long 174º28.22'W, depth 965m
Dredge off bottom UTC 07/01/03 0811hrs, lat 44º13.22'S, long 174º28.90'W, depth 874m (posn when stuck dredge was freed)
400kg. Mainly hard, phosphorite beds and nodules, some volcanic breccias, a few basalts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR73-1	15x13x7cm subangular	light grey, fresh basalt with outer 1cm weathered to orange-green. Phenos of dark green olivine or amphibole (5%), plagioclase (10%) and cpx (5%). No Mn crust.	Y	Y	Y	fsp		Y		some difficulty in getting consensus on mineralogy. Shape and different mineralogy may indicate this to be a dropstone.
DR73-2	6x6x6cm round cobble	very dark grey, apparently fresh, volcanic matrix. Phenos of yellow-green olivine (2-3%, either totally altered or 'freshest of the cruise so far'). Also 2-3% cpx phenos	Y	Y	Y?					not a dropstone. Does not appear to be a phosphatised, Mn cemented sandstone as once thought
DR73-3	18x18x6cm subrounded-subangular slab	light grey to light greenish grey quartz mica schist. 1% small (<1%) round, red minerals (garnet? hematite?).	Y					Y		only schist in the dredge, may be transported. GNS gets largest piece
DR73-4	20x8x10cm subrounded	volcanic conglomerate, epiclastic. 40% 1-15mm rounded red oxidized, vesicular basalt clasts in dark grey matrix	Y					Y		
DR73-5	15x5x11cm subrounded	volcanic conglomerate, epiclastic. 35% red, rounded vesicular basalt clasts similar to DR73-4, but overall smaller clasts (1-8mm) and matrix consisting of white carbonate	Y					Y		
DR73-6	18x18x9cm subrounded	brown, highly vesicular aphyric basalt. Strongly altered, 30% round vesicles filled with white calcite.	Y							
DR73-7	20x16x8cm subangular	volcaniclastic conglomerate Similar toDR73-4 and DR73-5. Matrix dark brown with abundant calcite veins	Y							
DR73-8	5x5x5xcm round	greyish-brown olivine (alt, orange) basalt clast from conglom. 20% amygdules mostly filled with white calcite and reddish Fe hydroxide	Y	Y?						needs a lot of picking and/or acid treatment to remove cc. More typical of basalts in the dredge (DR73-1 and 2 are not typical)
DR73-9	10x8x10cm rounded	volcaniclastic rock. Brown matrix with red brown rounded clasts (0.5-1cm). Matrix is coarse grained (0.1-1mm).	Y							
DR73-10	20x10x4cm	volcanic breccia with white calcite & zeolite matrix, 40-50% subrounded reddish basalt clasts. Vesicles filled with Fe hydroxide.	Y					Y		
DR73-11	8x8x8cm	volcanic breccia, similar to DR73-10 but with large relatively fresh (3cm) vesicular basalt clasts. Vesicles are mostly open.	Y							
DR73-12	10x10x10 round	brown to dark grey amygdaloidal basalt medium to strongly altered. 70% of vesicles are filled (calcite)	Y							
DR73-13	30x5x25 subangular	breccia (nonvolcanic), hard phosphatised								
DR73-14	40x20x10cm subrounded	sedimentary rock with hard, noncalc "serpentine-like" green cm thick layers of unknown composition, poss phosphatic						Y		
DR73-15	8x8x8cm round	Mn crust 4 cm thick							Y	
DR73-16	30cm long	phosphatised bone						Y		all to GNS to deliver to Ewan Fordyce, Otago University
DR73-17	3 pieces 5x5x5xcm round	weakly cemented yellowish grey limestone (wackestone) with abundant planktic forams and some reworked phosphatized larger bioclasts (echinoid spines)						Y		2 other pieces Hamburg group

STATION 74. CHAPMANS HILL
Northeastern slope of northern peak
Dredge on bottom UTC 07/01/03 1053hrs, lat 44º09.08'S, long 174º32.85'W, depth 871m
Dredge off bottom UTC 07/01/03 1154hrs, lat 44º09.40'S, long 174º33.02'W, depth 610m
150kg. Mostly coral fragments. A few hard, relatively fresh cc amygd ol basalt cobbles

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR74-1	12x6x5cm subrounded	hard, light grey ol phyric vesicular basalt. 15-20% vesicles (0.1-1.5mm), some filled with calcite. Olivine altered to Fe hydroxide.	Y	Y	Y					
DR74-2	15x11x5cm subangular	basalt clast similar to DR74-1 but more altered. Matrix grey to light brown.	Y	Y				Y		
DR74-3	7x9x4cm rounded	grey to light brown basalt.15-20% vesicles mostly filled with cc. 5-8% 1mm oliv phenos, altered. Coral growing on one side	Y	Y						
DR74-4	5x5x5cm subrounded	most dense (least vesicular) basalt of this dredge. 5% amygdules mostly filled with cc. Otherwise similar to DR74-1. Olivine altered.	Y	Y	Y					
DR74-5	9x5x6cm subangular	light brown olivine-phyric (10-15%) basalt	Y			cpx?				most strongly altered basalt of this dredge. Slight chance of fresh cpx but prob amygdule fill
DR74-6	20x15x7cm subangular	volcanic breccia. 60-70% subangular vesicular basalt. All clasts are strongly altered. Carbonate-cemented matrix.	Y					Y		no Mn crusts in dredge

STATION 75. UNLUCKY HILL
SW slope
Dredge on bottom UTC 07/01/03 1810hrs, lat 44º21.87'S, long 174º58.22'W, depth 742m
Dredge off bottom UTC 07/01/03 1841hrs, lat 44º21.649'S, long 174º57.977'W, depth 457m
Empty dredge

STATION 76. HOWSON A
Northern edge of main top
Dredge on bottom UTC 07/01/03 2349hrs, lat 43º56.12'S, long 175º18.16'W, depth 134m
Dredge off bottom UTC 08/01/03 0005hrs, lat 43º56.216'S, long 175º18.202'W, depth 98m
80kg. 99% modern bivalve & brachiopod shells, some live. One pebble altered volcanic breccia

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR76-1	7x5x4cm round, bryozoan-encrusted	hard, dark orange volcanic breccia. Clasts subangular poorly sorted 0.1-1 cm in matrix of altered volcanic sand possibly palagonitic. The larger clasts are of 10% plag- phyric basalt, with some tiny fresh grey enclaves. Calcite cement.	Y	Y	Y	fsp				May be possible to extract some lithics for chemistry if needed. Chem depends on TS observation.

STATION 77. HOWSON B
Northeastern edge of main top
Dredge on bottom UTC 08/01/03 0050hrs, lat 43º56.369'S, long 175º17.618'W, depth 130m
Dredge off bottom UTC 08/01/03 0116hrs, lat 43º56.357'S, long 175º17.676'W, depth 120m
0.5kg. Half dozen mussel shells and one piece brown-orange volcanic breccia

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR76-1	7x5x4cm subangular	fine volcanic breccia, clasts <3mm, strongly altered, colors black brown orange	Y					Y		too altered to analyse

STATION 78. HOWSON C
North side of small cone to east of main top
Dredge on bottom UTC 08/01/03 0145hrs, lat 43º56.656'S, long 175º17.296'W, depth 127m
Dredge off bottom UTC 08/01/03 0222hrs, lat 43º56.690'S, long 175º17.308'W, depth 104m
15kg. Mainly cemented broken shell debris. Two small pieces volcanic breccia.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES	
DR78-1	6x4x4cm subangular, encrusted by 1cm reef organisms	dark brown breccia. Clasts dark brown, <4mm, 40% orange phenocrysts (altered fdsp). Matrix grey + strong reaction with HCl.	Y								
DR78-2	8x4x2cm subangular, flat, encrusted by 3mm reef organisms	breccia. 40% dark grey and brown volcanic clasts, have vesicles/amygdules (5%, <1mm). Brown calcareous & alt volcanic matrix.	Y								
DR78-3	7x7x6cm angular	mussel debris (rudstone with some finer matrix), very weakly cemented, porous						Y		presumably Pleistocene, Hamburg	GNS +

STATION 79. HOWSON D
NW side of small cone to SW of main top
Dredge on bottom UTC 08/01/03 0308hrs, lat 43º57.195'S, long 175º18.889'W, depth 112m
Dredge off bottom UTC 08/01/03 0322hrs, lat 43º57.262'S, long 175º18.867'W, depth 103m
100kg. Mostly biological material. 1kg basalt pieces & breccia.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR79-1	8x4x5cm subangular, sawn to remove organic encrustations	hard, olive grey (5Y3/2) basalt. Fg gmass poss shows fsp (<1mm) but not as phenocryst. Amygdules (20%, <1mm) mainly cc filled.	Y	Y	Y			Y		
DR79-2	4x4x6cm subangular, encrusted	amygdaloidal aphyric basalt similar to DR78-1 but slightly less amyad (15%, cc & chlorite).	Y	Y	Y					
DR79-3	10x7x4cm subangular, encrusted	lava similar to DR78-1. More strongly altered.	Y							
DR79-4	10x5x4cm angular, encrusted	brownish grey amyd aphyric basalt. 40% cc amygdules in very different sizes (<< 1mm up to 1.5cm).	Y							
DR79-5	6x6x3cm angular	dark brownish grey amygdaloidal (cc, 30%, 2mm) olivine (alt, 1%) -phyric basalt.	Y	Y	Y			Y		
DR79-6	3x3x2cm angular, encrusted	olive grey aphyric amygd basalt. 10% amygd (<1mm)								
DR79-7	13x3x1cm angular	dark red volcanic breccia. 30% clasts of volcanic material (1-5mm). Matrix grey calcite. Intensely altered palagonite & scoria.								
DR79-8	25x13x3 angular	Same as DR79-7.	Y					Y		

STATION 80. CHARLTON A
Northern dredge on slope
Dredge on bottom UTC 08/01/03 0537hrs, lat 44º11.634'S, long 175º27.948'W, depth 253m
Dredge off bottom UTC 08/01/03 0604hrs, lat 44º11.733'S, long 175º27.889'W, depth 161m
250kg. 90% biological material. 10% basalts, ol + ol-cpx-phyric, some with megacrysts and ultramafic xenoliths

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR80-1	10x8x7cm subangular to subrounded, bryozoa encrusted	dark grey to brown amydaloidal (20% cc), olivine (alt 3%), cpx (fresh, <1%) basalt. Possible alt olivine megacryst.	Y	Y	Y	cpx		Y		
DR80-2	10x9x3cm subrounded, bryozoa encrusted	dark grey brown olivine basalt, matrix, 30% vesicles, cc filled. 3% altered olivine + traces of cpx	Y			cpx		Y		cpx megacryst in TS block
DR80-3	10x10x8cm subangular	hard, dk grey brown olivine basalt, 25% vesicles, cc filled. 5% altered olivine (3mm), no obvious cpx.	Y					Y		
DR80-4	10x6x4cm subrounded, encrusted	basalt like DR80-3 but only 10% amygdules.	Y	Y	Y			Y		best to analyse of the dredge
DR80-5	10x8x7cm subangular, encrusted	dark brown ol basalt. 15% cc amydules. No obvious cpx. Possible ol megacryst-xenocryst.	Y					Y		
DR80-6	5x5x2cm	amygdaloidal basalt like DR80-4, 7% amygdules.	Y	Y	Y					second best to analyse
DR80-7	20x15x7cm slab	red brown polymict volcanic breccia with very altered. varicolored + textured basaltic lavas						Y		
DR80-8	10x10x10cm	amygdaloidal basalt with xenoliths						Y		probable dunite + wehrlite xenoliths
DR80-9	one of pieces making up 150kg of dredge	porous limestone (rudstone) composed of (partly re-worked) shell and coral debris. With some micritic matrix.						Y		presumably Plio/Pleistocene age, piece to Hamburg
DR80-10	one of 3-4 pieces in dredge	hard, light yellowish grey, bryozoan limestone (rudstone), micritic matrix. Has angular volcanic lithic fragments.						Y		Paleogene age? Piece to Hamburg
DR80-11X	15x10x15cm	cc filled amydaloidal basalt. Largest amygdules of dredge, otherwise like DR80-3								
DR80-12X	8x7x6cm	volcanic breccia, cc cemented.								
DR80-13X	10x8x7cm subangular	amygd. lava with totally altered xenoliths, possible dunite.								xenoliths
DR80-14X	10x8x7cm subrounded	same as DR80-13x								xenoliths

STATION 81. CHARLTON B
Southern dredge near top of cone
Dredge on bottom UTC 08/01/03 0723hrs, lat 44º13.78'S, long 175º27.10'W, depth 124m
Dredge off bottom UTC 08/01/03 0747hrs, lat 44º13.86'S, long 175º27.10'W, depth 101m
400kg. Mainly one large tough boulder of brown calcite-cemented basaltic breccia. Half a dozen small rocks (alt basalt, lst and sst) and a few shells

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR 81-1	20x22x10cm piece hammered from 1x0.7x0.5m subangular, organism-encrusted boulder	tough olive grey-brown volcanic breccia. Clasts of olivine (probably fresh) cc amygdaloidal basalt, largest clasts up to 8mm in size, very strongly altered.	Y	?		ol?		Y		Will be difficult to extract individual clasts for work. TS will confirm freshness oliv, quality of sample and assist decision on future work.
DR 81-2	5x4x3cm subrounded	dark brown olivine (5%, alt) px (1%, fresh) calcite amygdaloidal (20%) basalt.	Y	Y						Will be hard to pick fresh groundmass
DR 81-3	15x10x3cm bored slab	porous orange-white limestone						Y		
DR 81-4	5x5x3cm subangular, sculpted	dark grey basaltic volcanic sandstone. Some bedding. Mn cement. Thin limestone cap on one face						Y		

STATION 82. HICKS
Southwestern slope
Dredge on bottom UTC 08/01/03 1040hrs, lat 44º27.75'S, long 175º21.19'W, depth 515m
Dredge off bottom UTC 08/01/03 1100hrs, lat 44º27.70'S, long 175º21.06'W, depth 386m
5kg. Altered calcite-amygdaloidal olivine-phyric basalts

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR82-1	17x10x10cm subrounded	olive-brown to orange-brown very altered olivine basalt. Amygdules filled with Mn and calcite	Y					Y		
DR82-2	7x3x4cm subrounded	basalt, similar to DR82-1 but more calcite	Y							
DR82-3	8x5x4cm subrounded	basalt, similar to DR82-1 but more calcite	Y							
DR82-4	6x3x5cm subrounded	olive-brown, vesicular (5%) olivine basalt, calcite in part of vesicules, very altered olivine phenocryst	Y							
DR82-5	8x5x4 cm subangular	olive brown to orange (where strongly altered) amygdaloidal (cc 30%) basalt.	Y	Y						best for chemistry. 3mm yellow calcite vein through the whole piece
DR82-6	8x5x4cm subangular	altered basalt, olive brown, similar to DR82-3								
DR82-7	7x3x4cm subangular	basalt, similar to DR82-1								
DR82-8	6x4x3cm subangular	basalt, similar to DR82-1								
DR82-9	10x6x3cm subangular	altered basalt, similar to DR82-1, but more altered, mainly orange and more Mn in vesicules								
DR82-10	8x8x5cm subangular	greyish orange limestone (wackestone-floatstone), mainly bivalve bioclasts, *Lithophaga* borings						Y		piece to Hamburg

STATION 83. FBI
South slope of southern cone
Dredge on bottom UTC 08/01/03 1336hrs, lat 44º40.833'S, long 175º12.754'W, depth 1024m
Dredge off bottom UTC 08/01/03 1423hrs, lat 44º40.517'S, long 175º12.756'W, depth 755m
200 kg. Mostly biological samples. Rocks mainly volcanic breccia; a few pieces of olivine basalt

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR83-1	15x12x8 cm rounded cobble	dark brown amygdaloidal (cc, 30%, 1mm) olivine (alt, 1%) basalt with large xenolith of greenish-yellow mg ?volcaniclastic sandstone.	Y	Y	Y			Y		up to 1.5 cm Mn-crust
DR83-2	14x14x4 cm angular, disc like	mod-strongly altered, brown-grey cc amydg (15%, 0.5 mm, half empty) aphyric basalt	Y	Y	Y			Y		very thin Mn-crust. Contains 4cm sandstone xenolith
DR83-3	13x7x4cm subrounded	brown-grey basalt similar to DR83-1 but more altd. 25% cc amyg (half empty).	Y							contains carbonate/phosphorite xenoliths
DR83-4	20x10x7cm	dark red polymict basaltic volcanic breccia. Clasts up to 5cm, strongly altered, cc amygdules. Cream coloured cc cement.						Y		
DR83-5	30x10x10cm	carbonate cemented basaltic breccia sim to DR83-4						Y		
DR83-6	20x20x20cm subang	breccia similar to DR83-4						Y		
DR83-7X	20x14x6cm	breccia similar to DR83-4					Y			
DR83-8X	25x18x12cm	breccia similar to DR83-4, but with large sandstone xenolith coated with thin lava film.					Y			3cm Mn crust
DR83-9X		breccia with 8cm carbonate clast					Y			
DR83-10X		breccia similar to DR83-4	Y				Y	Y		

STATION 84. GORE
SE flank
Dredge on bottom UTC 08/01/03 1807hrs, lat 44º36.673'S, long 175º45.024'W, depth 1192m
Dredge off bottom UTC 08/01/03 1903hrs, lat 44º36.38'S, long 175º45.26'W, depth 884m
600kg. Mostly phosphorite. 10% amygd alt ol basalts, some red volc breccias. 5% high grade met & plut dropstones.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR84-1	8x7x4 cm, subrounded	hard, dark brown olivine-phyric (alt, 5%, 1mm), calcite amygdaloidal (0.5mm, 10%) basalt	Y	Y				Y		
DR84-2	10x7x5 cm, subangular	hard, dark grey brown olivine (alt, 5%, 1mm) cc amygdaloidal (0.5 mm, 5%) basalt	Y	Y				Y		
DR84-3	12x10x9 cm, subrounded	hard, dark brown olivine basalt, like DR84-1, 2, but with oliv and amygdules up to 3mm. Amygd. filled with phosphate + calcite	Y					Y		minor PO4-veins
DR84-4	50x50x50 cm subrounded boulder, encrusted by organisms	hard, dark brown olivine (12%, < 0.5 mm, al.), cc amygd (2%)	Y	Y				Y		not much better than small pieces
DR84-5	20x20x10 cm, subrounded	dk orange brown lapilli volcanic breccia. Calcite-matrix, no bedding, poor sorting, clasts of red vesicular/amygdaloidal olivine basalt like the lavas	Y					Y		
DR84-6	10x6x5 cm subrounded	very hard pale yellow-white phosphate nodule						Y		
DR84-7	15x10x3 cm subangular slabby	very hard pale yellow bored phosphorite bed. Borings filled with mudstone and planktic foram-rich wackestone						Y		piece to Hamburg
DR84-8	7x7x6 cm subangular + 10x7x2 cm subangular	moderate hard, yellowish grey, partly phosphatized limestone (wackestone) abundant planktic forams						Y		piece to Hamburg
DR84-9	10x7x5 cm, subrounded	reddish brown ol basalt, amygdaloidal with ropy texture on surface								subaerial eruption?
DR84-10	7 cm dim. rounded	dark brown grey highly amygdaloidal (cc, 30%, 1mm) olivine (alt) basalt								
DR84-11	20x10x7 cm subangular	basalt, similar to DR84-2 but with phosphorite bed attached								
DR84-12x	15x12x10 cm subrounded	basalt sim. to DR84-10, amygdules to 5mm								
DR84-13x	25x15x15 cm subangular	red volcanic breccia with calcite cement. Clasts like other lavas in dredge								
DR84-14	35x7x4 cm subrounded	phosphatised bone						Y		for Ewan Fordyce, Otago University

STATION 85. MONKHOUSE
~ 2.5 nm east of Monkhouse position, base of ridge-like structure
Dredge on bottom UTC 09/01/03 0216hrs, lat 44º39.75'S, long 176°17.35'W, depth 740m
Dredge off bottom UTC 09/01/03 0240hrs, lat 44º39.78'S, long 176º18.10'W, depth 540m (position when stuck dredge became free)
4kg. Half corals & bryozoa. Half breccias and fresh grey basalts with alt olivine phenos and calcite amygdules

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR85-1	13x8x8 cm, subangular	hard dark grey basalt, 5% altered olivine-phenocrysts (1mm), 5% chlorite + calcite amygdules	Y	Y	Y			Y		possibility of fresh olivine or plagioclase, check TS
DR85-2	7x5x2 cm, subangular	hard dark grey basalt, 3% altered olivine phenocrysts (<2mm), 1% calcite + chlorite amygdals	Y							
DR85-3	8x2x2 cm, angluar	hard dark grey basalt, 2% altered olivine phenocrysts (<2mm), 1% chlorite+calcite amygdules	Y					Y		possibility of fresh olivine or plagioclase, check TS
DR85-4	8x5x4 cm, angular	hard dark grey basalt, 1% altered olivine phenocrysts (1 mm), vesicles (7%, < 4mm, altered)	Y							largest amygdules of dredge
DR85-5	7x7x4 cm, subangular	hard grey basalt, 10% phenocrysts, 1% vesicles < 3 mm, not filled	Y							possibility of fresh olivine or plagioclase, check TS
DR85-6	5x5x3 cm, subangular	breccia, volcanic clasts (< 6 mm), totally altered + palagonised, matrix grey (20%)	Y							
DR85-7	6x6x3 cm, subrounded	lava, same as DR85-1								
DR85-8	6x4x4 cm, subangular	lava, same as DR85-1								
DR85-9	7x7x5 cm, subrounded	lava, same as DR85-1								
DR85-10	2x2x2 cm, angular	lava, same as DR85-1								

STATION 86. JONES
South-facing nose dredged in NE direction
Dredge on bottom UTC 09/01/03 0757hrs, lat 44º35.835'S, long 176°31.973'W, depth 563m
Dredge off bottom UTC 09/01/03 0824hrs, lat 44º35.787'S, long 176º30.668'W, depth 421m
250kg. 99% pieces of broken, living coral mound. Five small pieces of altered olivine-phyric basalt

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR86-1	8x5x3cm subangular	hard, 5% alt olivine basalt, very strongly altered, orange to brown matrix, 20% vesicles filled with calcite								
DR86-2	4x4x2cm subangular	piece of olivine (alt) basalt, similar to DR86-1 but slightly fresher. all vesicles filled with calcite.								inter-amygdule groundmass pieces too small to separate
DR86-3	7x5x3cm subangular	piece of basalt, very strongly altered, fewer vesicles than other samples of this dredge						Y		
DR86-4	17x7x5cm subangular	piece of volcanic breccia, orange brown palagonite, altered basalt clasts up to 1.5cm, cc cemented								
DR86-5	7x4x3cm subangular	piece of cc cemented volcanic breccia, clasts up to 1cm, mostly strongly altered but also with palagonitic areas (fresh glass?).	Y							

STATION 87. PERRY
SE flank of table mountain
Dredge on bottom UTC 09/01/03 1145hrs, lat 44º38.581'S, long 176°49.498'W, depth 684m
Dredge off bottom UTC 09/01/03 1232hrs, lat 44º38.376'S, long 176º49.121'W, depth 511m
15kg. One third biological samples, two thirds fresh ol+cpx+-plag porphyritic basalts. Three dropstones

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR87-1	8x6x4 cm, subangular	hard fresh pale grey basalt. Pyroxene (v fresh, 10%, 8 mm) and olivine (alt 5%) phenos. Plagioclase in groundmass. 5% amygdules (mainly in altered part)	Y	Y	Y	px				shiny black euhedral px phenos stand clear of the surface of the sample
DR87-2	7x4x3 cm subangular	piece of basalt, pale grey, more amygdules than DR87-1, otherwsie similar	Y	Y		px				
DR87-3	7x5x2 cm, angular	piece of basalt, pale grey, similar to DR87-2	Y			px				
DR87-4	7x7x4 cm, angular	hard, grey, fresh ol, px, plag-phyric basalt. Px phenos (2%, 5mm), plagioclase phenos (3%, < 3mm), olivines (altered) and amydules (chlorite, 5%)	Y	Y	Y	px fsp				
DR87-5	6x5x4 cm, angluar	grey basalt. Phenos are px (7%, <4mm), olivine (alt chlorite). Plag is in groundmass 5% chl amygdules	Y			px fsp				
DR87-6	7x5x4 cm subangular	dark grey, pyroxene (15%, <5mm) olivine (chloritised) basalt. Plag in groundmass, 7% amygdules	Y	Y	Y	px fsp				
DR87-7	10x8x7 cm, subrounded	piece of volcanic breccia, orange calcitic cement, amygdaloidal clasts	Y					Y		brecciated basalt instead of volcanic breccia?
DR87-8	8x5x5 cm, subangular	grey brown basalt, clinopyroxene phenocrysts (10%, <1cm), olivines (altered and replaced by chlorite). 5% amygdules.								
DR87-9	9x6x6 cm, subangular	altered basalt, clinopyroxene (7%, < 5mm), olivine (2%) and plagioclase (1%) in groundmass, 5% amygdules						Y		
DR87-10	10x6x5 cm, subangluar	volcanic, palagonitic and calcitic breccia, clasts of very altered basalt (orange-brown) with clinopyroxene and calcite (yellow to orange), white stuff in vesicles								brecciated basalt?
DR87-11x	Three 10x7x5 cm and smaller, subangular	dropstones of gneiss and granite								

STATION 88. THOMPSON
SW corner, steepest slope
Dredge on bottom UTC 09/01/03 1436hrs, lat 44º44.268'S, long 176°48.072'W, depth 988m
Dredge off bottom UTC 09/01/03 1545hrs, lat 44º43.932'S, long 176º47.751'W, depth 733m
400kg. Mainly altered volc breccia & basalts, a few fresher basalts & dropstones. Small amount of attached biological material

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR88-1	10x8x6 cm, round, encrusted	hard dark grey to light brown aphyric basalt, chloritic, mod altered	Y	Y	Y?			Y		
DR88-2	5x5x5 cm round	dark grey to bluish olivine basalt. Chloritic, 10% vesicles (1mm), filled with calcite, 2-3% altered olivine phenos	Y	Y	Y?					freshest basalt of dredge
DR88-3	30x40x30 cm, subangular	brown olivine basalt lava, vesicles filled with calcite, 4% altered olivines (1 mm), some fresh parts	Y	Y				Y		
DR88-4	40x40x30 cm,	basalt, similar to DR88-3, but some vesicles are filled with Mn	Y					Y		
DR88-5	20x10x8 cm,	brownish to grey matrix, moderately altered ol. basalt. 10% vesicles, some filled with calcite, 3% altered ol., basalt has a fresh inner core	Y	Y						
DR88-6	20x20x10 cm,	basalt, similar to DR88-5, but totally altered								
DR88-7	20x10x10 cm,	volcanic breccia, calcite cemented, zonation of yellow-brown and green clasts	Y					Y		
DR88-8x	30x20x10 cm,	strongly altered basalt, similar to DR88-6								
DR88-9x	20x10x5 cm	grey, very hard, platy limestone (mudstone), rare planktic forams. With siliceous material								piece to Hamburg
DR88-10x	10x8x5 cm	light yellowish grey, hard limestone (floatstone, micritic matrix) with cm-sized coral frag. + globigerinids and cm-sized subangular volc. clasts								piece to Hamburg
DR88-11x	50x40x40 cm subangular	granite								dropstone from Antarctica
DR88-12x	one bag	granites, gneisses, pegmatites								dropstones from Antarctica

STATION 89. CLERKE A
SE slope
Dredge on bottom UTC 10/01/03 0231hrs, lat 43º52.375'S, long 177°07.473'W, depth 127m
Dredge off bottom UTC 10/01/03 0248hrs, lat 43º52.327'S, long 177º07.416'W, depth 84m
150kg. Mainly as one bio-encrusted volc breccia boulder. A few pieces mostly breccias, one basalt, one PO4-nodule

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR89-1	6x5x4 cm, subrounded, encrusted	hard, dark grey, calcite pervaded basalt with 5-10mm brown weath rind. Cc replaces olivine phenos (3mm, 5%). Small vesicles (< 0.5mm, 5 %)	Y	Y						Probably an autobrecciated flow margin - explains variable texture and alteration
DR89-2	8x7x5 cm, subangular	dark-brown-red breccia. Basaltic clasts (similar to DR89-3, but more clay-altered, also more alteration than DR89-4)	Y					Y		
DR89-3	1.5x1.5x1cm subang, sawed out piece	hard black px-phyric (10%), vesicular (15%) basalt. Minimal vesicle filling.	Y	Y	Y	cpx				this is a clast from breccia DR89-4
DR89-4	10x8x4cm subang encrusted	dark brown to black volcanic breccia. Clasts fresh and with open, unfilled vesicles but are <1cm in size	Y	Y	Y					
DR89-5	0.7x0.4x0.4cm subang thickly encrusted subang boulder	volcanic breccia similar to DR89-6								
DR89-6	15x15x12cm subrounded	orange-brown strongly altered breccia, basalt clasts 1-6mm. White-grey matrix cc or zeol								
DR89-7	15x10x7cm subrounded	volcanic breccia, multicoloured clasts. Broadly similar to DR89-6								
DR89-8	7x7x2cm subrounded, flat	breccia like DR89-6 but more strongly altered								
DR89-9	5x4x3cm subrounded	breccia like DR89-5								
DR89-10	6x4x3cm subrounded	breccia like DR88-5								
DR89-11	5x3x3cm subang	phosphate nodule, core is a volcanic breccia								

STATION 90. CLERKE B
Cone or ridge structure S of DR89, SE slope
Dredge on bottom UTC 10/01/03 0347hrs, lat 43º52.877'S, long 177°07.563'W, depth 156m
Dredge off bottom UTC 10/01/03 0432hrs, lat 43º52.847'S, long 177º07.522'W, depth 148m
Cable broke, dredge was lost

STATION 91. MANLEY
SW flank
Dredge on bottom UTC 10/01/03 0959hrs, lat 43º22.090'S, long 177°22.456'W, depth 204m
Dredge off bottom UTC 10/01/03 1019hrs, lat 43º22.023'S, long 177º22.370 'W, depth 189m
80kg. Mainly red- orange volcanic breccias. Some grey breccias with very small, fresh basalt clasts.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR91-1	17x14x10 cm, subrounded	fairly fresh breccia with white to bluish-grey matrix, clasts (40%) mainly of brownish-green basalt 0.2-1.5cm in size but include some fresh black nonvesic cpx-phyric basalts	Y	Y	?	cpx		Y		breccia matrix is carbonate cemented. Could extract fresh clasts for dating and analysis
DR91-2	14x8x8 cm pebble	similar to DR91-1	Y							
DR91-3	14x8x18cm rounded breccia boulder	similar to DR91-1	Y							
DR91-4	8x4x6cm subangular	similar to DR 91-1	Y							
DR91-5	6x6x7cm rounded	altered breccia. Clasts 30-40% rounded, some nonvesicular brownish plag, cpx-phyric basalt clasts	Y							carbonate cemented white matrix
DR91-6	two 20x20x10 cm hammered pieces from a large block	altered basalt breccia with 40-50% subrounded clasts, 1-20mm. Most clasts are brownish altered ~ 10-15% are dark and fresher.	Y	Y						
DR91-7x	20x15x10cm	similar to DR91-1								
DR91-8x	30x40x20cm, subangular	similar to DR91-5								

STATION 92. HAYSTACK A
Plain area on Chatham rise, at "carbonate mound" locality
TV-grab over side UTC 10/1/03 2136hrs, lat 43º03.645'S, long 178º38.904'W, depth 527m, cable 0m
TV-grab on bottom UTC 10/1/03 2156hrs, lat 43º03.665'S, long 178º39.006'W, depth 528m, cable 517m
TV-grab closed UTC 10/1/03 2205hrs, lat 43º03.659'S, long 178º39.058'W, depth 526m, cable 535m
TV-grab on deck UTC 10/1/03 2221hrs, lat 43º03.600'S, long 178º39.118'W, depth 527m, cable 0m
Full, sediment with macrofauna, no rocks

STATION 93. HAYSTACK B
Plain area on Chatham rise, at "carbonate mound" locality
Box corer over side UTC 10/1/03 2250hrs, lat 43º03.68'S, long 178º39.06'W, depth 527m, cable 0m
Box corer on bottom UTC 10/1/03 2305hrs, lat 43º03.68'S, long 178º39.06'W, depth 527m, cable 528m
Box corer on deck UTC 10/1/03 2318hrs, lat 43º03.696'S, long 178º39.006'W, depth 526m, cable 0m
Half full, sediment, no rocks

STATION 94. MATHESON BANK A
Southern margin
Dredge on bottom UTC 11/01/03 1416hrs, lat 44º00.346'S, long 179°12.958'W, depth 285m
Dredge off bottom UTC 11/01/03 1435hrs, lat 44º00.226'S, long 179º13.047'W, depth 268m
No rocks, only sediment

STATION 95. MATHESON BANK B
Southern margin
Dredge on bottom UTC 11/01/03 1512hrs, lat 43º59.926'S, long 179°14.848'W, depth 272m
Dredge off bottom UTC 11/01/03 1540hrs, lat 43º59.751'S, long 179º14.868 'W, depth 252m
No rocks, only sediment and fragmented seastars

STATION 96. SILKE VULKAN

Northern slope of eastern cone of a group, east of Veryan Bank

Dredge on bottom UTC 12/01/03 1743hrs, lat 44º03.058'S, long 176°27.666'E, depth 605m

Dredge off bottom UTC 12/01/03 1831hrs, lat 44º03.263'S, long 176º27.608'E, depth 405m

400kg. 98% of amyg brown-black ol+cpx phyric basalt, some calcite cemented breccia, one shelly limestone. Two dropstones (not archived)

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR96-1	8x7x5 cm, subangular	hard, grey basalt 5% olivine , 2% cpx phenos (< 2 mm). 20% amygdules (cc. <2mm. 1/10 filled)	Y	Y	Y	cpx				
DR96-2	10x10x3 cm, subangular	basalt sim. to DR96-1 except amygdules 15%, <3 mm. 1/10 filled	Y	Y	Y	cpx				
DR96-3	15x15x8 cm, subrounded	basalt sim. to DR96-1, amygdules 5%, <1cm, 1/2 have idiomorphic calcite-crysts in part filled vesicles	Y			cpx		Y		
DR96-4	25x25x20 subrounded, hammered in small pieces	basalt, sim. to DR96-1, vesicles 20% , <2mm, 1/10 filled	Y	Y		cpx		Y		
DR96-5	8x8x8 cm, subrounded	basalt sim. to DR96-1, 30% vesicles (<1cm, 1/20 filled)	Y			cpx				
DR96-6	15x10x8 cm, subrounded	breccia with 70% white, calcite matrix and 30 % volcanic clasts, angular and poorly sorted (1 mm - 1 cm) of brown, strongly altered, amygdaloidal basalt	Y			cpx		Y		
DR96-7	8x8x5 cm, subrounded	basalt, sim. to DR96-1, vesicles 20%, < 5mm, very few (1/20) filled with yellowish secondary mineral				cpx				
DR96-8	15x15x15 cm, subrounded	basalt, sim. to DR96-1, 40% vesicles, > 1/2 filled with calcite				cpx				
DR96-9	10x10x8 cm, subrounded	brown, strongly altered, brecciated basalt. Cc cement, intralavaclasts (70%, <5cm) highly vesicular (50%. 1mm)								
DR96-10	from 15x15x10cm volcanic breccia	yellowish-white limestone rind on volcanic breccia that contains volcanic clasts (< 5 mm)								
DR96-11	10x10x5 cm, subrounded	limestone (grainstone-rudstone), larger clasts are bivalve shells (5%, <1cm), colour of sandy matrix is grevish-yellowish						Y		GNS + Hamburg
DR96-12x	25x17x12 cm, subrounded	basalt, sim. to DR96-1, surface has fluidal volcanic texture. outer parts are brown				cpx				
DR96-13x	15x10x12 cm, subrounded	hard, grey cc amygdaloidal cpx-phyric basalt				cpx				
DR96-14x	10x4x4cm subang	basalt sim to DR96-1. Highly amygdaloidal (25%, <3mm, cc)				cpx				
DR96-15x	20x15x15cm subrounded	basalt sim. to DR96-1. 20% amygdules				cpx				
DR96-16x	20x15x10cm subrounded	brecciated basalt, strongly altered. Clasts <15cm. Yellowish cc cement								

STATION 97. ORTON

Small cone at base of SE flank of Veryan Bank

Dredge on bottom UTC 12/01/03 2250hrs, lat 44º21.02'S, long 176°11.40'E, depth 575m

Dredge off bottom UTC 12/01/03 2334hrs, lat 44º21.15'S, long 176º11.16'E, depth 400m

50kg. 1/3 ol-px and ol-px-hb-phyric basalts, some quite fresh. 2/3 volcanic breccias with clasts of these lavas

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR97-1	20x10x10cm subrounded	fresh, grey nonvesicular ol<cpx-phyric basalt. 25% phenos (<7mm)	Y	Y	Y	cpx				Only lava in dredge with no hbl, does not seem to be a dropstone
DR97-2	15x15x10cm subrounded	grey hb<px<ol-phyric basalt, some fresh parts. 15% phenos (<2mm). Elongated vesicles (7%, 1-3cm)	Y	Y	Y	cpx hb		Y		
DR97-3	15x10x10cm subrounded	dark grey hb<ol<px-phyric basalt. 7%phenos (<3mm). Brown alteration along cracks	Y	Y	Y	cpx hb				
DR97-4	10x10x7cm subrounded	grey hb<px<ol-phyric basalt. 7% phenos, 7% large cc amygdules to 3cm	Y	Y	Y	cpx hb		Y		
DR97-5	10x8x5cm subangular	brownish-grey hb<ol<cpx-phyric basalt. 10% phenos, 2% cc amygdules <2mm	Y			cpx hb				
DR97-6	12x12x12cm subangular	brown volcanic breccia with grey-white cc matrix. Clasts <3cm amygd hb ol px basalts. Some clasts fresher and grey	Y			garn hb				Contains 2-3mm diameter clear red mineral grain = garnet? Lots of detrital hbl. DR97-7 is a clast from this piece
DR97-7	6cm clast sawn from breccia DR97-7	fresh grey hb<px<ol-phyric basalt, nonvesicular. 15% phenos	Y	Y		cpx hb				Clast from DR97-6 breccia
DR97-8	10x7x6cm subang	breccia. 15% mm-cm greenish brown alt volcanic clasts, 85% partly phosphatised micritic limestone matrix. Mollusc & bryozoan fragments, forams						Y		piece to Hamburg
DR97-9X	9x7x6cm subang	breccia, cc matrix, green-brown basalt clasts.								one v large clast. Sim to DR97-6
DR97-10X	15x10x7cm subang	breccia similar to DR97-6								
DR97-11X	10x7x6cm subang	breccia similar to DR97-6								
DR97-12X	15x10x10cm subangular	breccia similar to DR97-6								

STATION 98. GATHREY
Small cone at base of S flank of Veryan Bank
Dredge on bottom UTC 13/01/03 0214hrs, lat 44º24.135'S, long 175°55.220'E, depth 490m
Dredge off bottom UTC 13/01/03 0351hrs, lat 44º24.18'S, long 175º55.10'E, depth 420m (best estimate, dredge stuck)
350 kg. Fresh olivine-phyric, calcite-amygdaloidal basalts, a few breccias.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR98-1	15x10x10cm subangular	hard, dark grey olivine (alt, 7%, 1mm) phyric basalt. Chl + cc amygdaloidal (10%, 3mm)	Y	Y	Y			Y		<0.5mm Mn rind
DR98-2	40x40x30cm subangular	tough, dark grey basalt similar to DR98-1 but amygdules smaller and closer together	Y	Y	Y			Y		harder to separate groundmass from amygdules than DR98-1. <0.5mm Mn rind
DR98-3	15x15x7cm subangular	hard, brown cc-cemented basaltic lapilli tuff breccia. Clasts same as DR98-1 but amygdules <1mm	Y					Y		Mn coated <0.5mm on outside. Most rocks in this dredge look black on exterior surfaces
DR98-4	10x10x3cm subangular	volcanic breccia like DR98-3 but 0.5-1mm Mn rind coats and pervades surface and cracks							Y	for Mn studies. Probably the shallowest water depth on cruise that rocks have had Mn rinds on them
DR98-5	0.9x0.5x0.4m subrounded, bioencrusted boulder	brown basaltic breccia like DR98-6, perhaps grading into brecciated basalt, flowtop?	Y					Y		no Mn rind
DR98-6	20x15x10cm subrounded	cc-cemented lapilli volcanic breccia like DR98-3								<0.5mm Mn rind
DR98-7	8x8x7cm subangular	dark grey basalt like DR98-1 but more cc								
DR98-8x	approx 8 5x4x3cm subang pieces	cc amygdaloidal basalt like DR98-1					x			

STATION 99. ANJA VULKAN
300m high cone 5nm SW of Gathrey
Dredge on bottom UTC 13/01/03 0619hrs, lat 44°30.479'S, long 175°51.062'E, depth 731m
Dredge off bottom UTC 13/01/03 0721hrs, lat 44°30.512'S, long 175°50.955'E, depth 644m
450kg. Hard, dark brownish grey sparsely olivine-phyric calcite-amygdaloidal basalt. A few pieces volcanic breccia with limestone matrix

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR99-1	10x8x7 cm, subrounded	hard, very dark brown sparsely olivine phyric (1 %, 1 mm, altered) amygdaloidal (25 %, 2 mm 1/4 filled with cc) basalt	Y	Y	Y			Y		
DR99-2	20x13x10 cm, subrounded	hard, very dark brown sparsely ol-phyric basalt like DR99-1,but amygdals 15 %, 3 mm, 50 % filled with cc	Y	Y				Y		
DR99-3	20x20x20 cm, subangular	hard basalt like DR99-2, amygdules slightly smaller (2 mm), 20 % filled with cc, sample has small veins of carbonate	Y					Y		
DR99-4		basaltic breccia with limestone matrix, clasts are dark brown altered, 1-4 cm, angular, otherwise like DR99-1, matrix is a hard floatstone with micritic matrix with abundant planktic formas	Y					Y		Hamburg
DR99-5x	1.2x0.6x0.5m, subangular	boulder of amygd. basalt like DR99-2, taken 3 pieces								
DR99-6x	15x10x8 cm, subrounded	amygd. basalt like DR99-3, but 90% of vesicles filled with calcite, browner								
DR99-7x	20x20x12 cm, subangular	amygd. basalt like DR99-1, but browner and more calcite								
DR99-8x	8x7x6 cm, subrounded	sim. to DR99-7x								
DR99-9x	10x10x7 cm, subrounded	altered cc-amygd. basalt								
DR99-10x	7x7x6 cm,	altered cc+chl-amygd. basalt								

STATION 100. YOUNG NICK (Herzer et al.1989 Knoll A)
NE part
Dredge on bottom UTC 13/01/03 1809hrs, lat 44º48.79'S, long 174°56.31'W, depth 896m
Dredge off bottom UTC 13/01/03 1856hrs, lat 44º49.07'S, long 174º56.41'W, depth 680m
No rocks

STATION 101. JORDAN
300m high cone 4 nm NW of Young Nick
Dredge on bottom UTC 13/01/03 2023hrs, lat 44º45.326'S, long 174°52.612'E, depth 853m
Dredge off bottom UTC 13/01/03 2108hrs, lat 44º45.702'S, long 174º52.793'E, depth 610m
1kg. Two rocks: rounded cobble fresh grey ol-phyric vesicular basalt and dark brown volcanic breccia

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR101-1	12x10x8 cm, rounded, with a few encrustations	grey, hard, sparsely olivine-phyric (0.7mm, 2% alt.) vesicular basalt. Fine grained feldspars visible in matrix. Some loose clay in vesicles.	Y	Y	Y			Y		May be transported, but probably not an ice dropstone
DR101-2	7x6x5 cm , subrounded	dark brown-red volcanic breccia. Very altered clasts of sparsely ol-phyric amygdaloidal (zeol & PO4) basalt	Y					Y		clasts broadly similar to DR101-1; check TS as this is important for dropstone interpretation

STATION 102. READING
Small cone, 1.5 nm W of Jordan
Dredge on bottom UTC 13/01/03 2249hrs, lat 44º45.85'S, long 174°51.04'E, depth 821m
Dredge off bottom UTC 13/01/03 2325hrs, lat 44º45.135'S, long 174º51.024'E, depth 631m
0.1kg. One piece coral and one small broken piece brown zeol-amygd olivine-phyric basalt

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR102-1	4x4x2cm subangular piece with broken face	hard, brown ol-phyric (1mm, 7% alt) amygdaloidal (zeol, 0.5-1mm, 50% filled) basalt	Y					Y		Will be almost impossible to analyse groundmass without including zeolite

STATION 103. URRY PLAIN
Plain area among eastern Urry Knolls
TV-grab over side UTC 14/1/03 0010hrs, lat 44º45.273'S, long 174º49.117'W, depth 885m, cable 0m
TV-grab on bottom UTC 14/1/03 0023hrs, lat 44º45.314'S, long 174º49.086'W, depth 885m, cable 872m
TV-grab closed UTC 14/1/03 0040hrs, lat 44º45.211'S, long 174º49.065'W, depth 885m, cable 876m
TV-grab on deck UTC 14/1/03 0057hrs, lat 44º45.271'S, long 174º49.105'W, depth 886m, cable 0m
Sediment only, no rocks.

STATION 104. FORWOOD
Prominent cone, central part of Urry Knolls
Dredge on bottom UTC 14/01/03 0406hrs, lat 44º45.90'S, long 174°23.907'E, depth 770m
Dredge off bottom UTC 14/01/03 0502hrs, lat 44º46.24'S, long 174º23.902'E, depth 594m
1400kg. 1/8 corals, 1/4 fresh bclck ol-phyric vesic basalts, 5/8 red-brown volc breccias, grading to rare sandy limestones.

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR104-1	20x18x8cm subrounded	hard black olivine-phyric (5-10%) vesicular (5%) basalt. About 1% fresh cpx phenocrysts	Y	Y	Y	cpx				some olivine altered to calcite? Or may be fresher than it appears (comment applies to all lavas in DR104)
DR104-2	10x10x10cm subangular	same as DR104-1	Y	Y	Y	cpx				
DR104-3	12x10x9cm subangular	same as DR104-1	Y	Y	Y	cpx		Y		
DR104-4	8x8x7cm subrounded	hard black olivine-phyric (2%) vesicular (10%) basalt. No cpx phenocrysts	Y	Y	Y					
DR104-5	12x12x10cm subangular	same as DR104-4	Y	Y	Y			Y		
DR104-6	12x8x6cm subrounded	same as DR104-4	Y	Y	Y					
DR104-7	11x11x10cm subangular	hard black olivine-phyric (10%) vesicular (10%) basalt. No cpx phenocrysts	Y	Y	Y					
DR104-8	15x10x6cm subangular	same as DR104-7	Y	Y	Y			Y		
DR104-9	10x9x7cm subangular	same as DR104-7	Y							
DR104-10	8x8x7cm subrounded	hard brownish-black olivine-phyric (5%) vesicular (2%) basalt with xenolith of ?altered ultramafic	Y					Y		
DR104-11	8x7x6cm rounded	red-brown ropy-texture-on-surface lava.								volcanic bomb?
DR104-12	20x20x8cm slab subrounded	volcanic breccia. Red-brown basaltic clasts (80%, 0.2-4cm) of alt ol-phyric scoriaceous basalt. Cream coloured micritic limestone matrix (20%)	Y					Y		
DR104-13	12x10x7cm subangular	volcanic breccia Varicoloured but mainly red-brown basaltic clasts (25%, 0.1-0.7cm). Cream-coloured limestone matrix	Y					Y		
DR104-14	8x7x3cm subangular	cream-brown micritic sandy limestone with small angular volcanic classts 0.1-0.3cm						Y		piece to Hamburg
DR104-15	10x10x6cm yellow-brown	yellow-brown shelly and micritic limestone with attached red-brown volcanic breccia like DR104-12						Y		piece to Hamburg
DR104-16X	18x18x13cm subangular, unsawn	basalt with grooves (flow structure) on one side					Y			
DR104-17X	20x18x10cm subrounded, unsawn	basalt					Y			
DR104-18X	20x12x12cm subrounded, unsawn	basalt					Y			
DR104-19X	12x12x12cm subangular, unsawn	basalt					Y			
DR104-20X	25x17x12cm subangular	red-brown volcanic breccia with little to no carbonate matrix					Y			
DR104-21X	30x15x10cm, subangular	red-brown volcanic breccia similar to DR104-12 but with limestone-filled cracks					Y			

STATION 105. BOOTIE
Prominent cone, central part of Urry Knolls. (Herzer et al. 1989 Knoll C)
Dredge on bottom UTC 14/01/03 0739hrs, lat 44º36.121'S, long 174°14.77'E, depth 719m
Dredge off bottom UTC 14/01/03 0815hrs, lat 44º36.32'S, long 174º14.80'E, depth 597m
1000kg. Mainly fresh vesicular ol, cpx-phyric lavas (some cc in amygdules)

SAMPLE #	SIZE & SHAPE	ROCK TYPE	TS	CHEM	Ar	GL/MIN	ARCH	GNS	Mn	NOTES
DR105-1	25x10x10cm subangular	hard, dark grey olivine (alt, 3%) clinopyroxene (fresh 3%) vesicular (10%, <1mm) basalt. Some vesicles clay filled	Y	Y	Y	cpx		Y		
DR105-2	10x10x8cm subrounded	same as DR105-1 but 3% vesicles 0.5-1mm	Y	Y	Y	cpx		Y		
DR105-3	13x10x7cm subrounded	same as DR105-1 but 3% vesicles 1-2mm	Y	Y	Y	cpx		Y		
DR105-4	15x10x8cm subangular	same as DR105-1 but 20% vesicles, some filled with clay	Y	Y	Y	cpx		Y		
DR105-5	hammered from 50x50x25cm subangular slab	same as DR105-1, vesicles flow aligned	Y	Y	Y	cpx		Y		
DR105-6	15x10x5cm subangular	volcanic breccia/limestone. Clasts <5cm of altered basalt. Matrix yellow limestone 50%	Y					Y		
DR105-7	10x5x3cm subangular	volcanic breccia, lots of grey limestone matrix, poorly sorted basalt clasts <1mm to 1cm.						Y		piece to Hamburg
DR105-8	15x15x5cm subrounded	volcanic breccia, v dark brown matrix, altered clasts and matrix								
DR105-9	15x10x10cm subangular	basaltic breccia like DR105-6, large clasts similar to DR105-1.								
DR105-10X	30x20x20cm subrounded	basalt like DR105-3					Y			
DR105-11X	20x15x10cm subrounded	basalt same as DR105-10X					Y			
DR105-12X	30x30x15cm subangular	voclanic breccia, clasts up to 10cm basaltic, yellow-brown matrix, strongly altered					Y			

SO168 Soft Sediment Samples obtained with sediment tubes, video grab sampler and box corer

Abbreviations used:

sediment tubes:	SR
video grab sampler:	GTV A
box corer:	GKG

abundant:	a
common:	c
few:	f
rare:	r

STATION 1. MOUNT SPONG
SW inner wall of crater
Dredge on bottom UTC 14/12/02 1050hrs, lat 39º48.814'S, long 167º14.291'E, depth 1076m
Dredge off bottom UTC 14/12/02 1120hrs, lat 39º48.803'S, long 167º14.013'E, depth 972m

SR, no sediment obtained

STATION 2. MOUNT SPONG
W inner wall of crater
Dredge on bottom UTC 14/12/02 1237hrs, lat 39º48.502'S, long 167º14.397'E, depth 1055m
Dredge off bottom UTC 14/12/02 1304hrs, lat 39º48.523'S, long 167º14.196'E, depth 957m

SR, no sediment obtained

STATION 3. GRAVEYARD SEAMOUNT
NE flank
Dredge on bottom UTC 16/12/02 2048hrs, lat 42º45.088'S, long 179º59.092'W, depth 1018m
Dredge off bottom UTC 16/12/02 2118hrs, lat 42º45.094'S, long 179º59.229'W, depth 976m

SR, no sediment obtained

STATION 4. GRAVEYARD SEAMOUNT
Top
Dredge on bottom UTC 16/12/02 2237hrs, lat 42º45.48'S, long 179º59.36'W, depth 807m
Dredge off bottom UTC 16/12/02 2259hrs, lat 42º45.650'S, long 179º59.365'W, depth 773m

SR, no sediment obtained

STATION 5. MORGUE SEAMOUNT
Eastern base
Dredge on bottom UTC 17/12/02 0021hrs, lat 42º42.687'S, long 179º57.049'W, depth 1185m
Dredge off bottom UTC 17/12/02 0132hrs, lat 42º42.830'S, long 179º57.182'W, depth 1025m

SR, sediment obtained but no smear slide sample taken

STATION 6. HEADSTONE SEAMOUNT
East side
Dredge on bottom UTC 17/12/02 0301hrs, lat 42º40.6'S, long 179º57.0'W, depth 1261m
Dredge off bottom UTC 17/12/02 0345hrs, lat 42º40.690'S, long 179º57.362'W, depth 1173m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (a), echinoid spines (c-a), *Gyroidinoides* (r), gastropods (r)	90/10	little	small volcanic fragments (f) + quartz grains (f)	yellowish grey	relatively many fresh looking forams;~10 benthic species including *Oolina hexagona* , *Anomaloides* ?, *Spirilina* ?, *Cassidulina* ?

STATION 7. SHIPLEY SEAMOUNT
Middle part of eastern flank
Dredge on bottom UTC 17/12/02 1409hrs, lat 41º49.893'S, long 179º28.195'W, depth 2097m
Dredge off bottom UTC 17/12/02 1517hrs, lat 41º49.491'S, long 179º28.512'W, depth 1773m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Orbulina* (r)	90/10	dominant	glauconite grains (f)	yellowish grey	relatively few forams; few fresh and common fragmented forams; +5 benthic species including *Lagena*, *Bulimina* (with 4 long spines on apex)

STATION 8. SHIPLEY SEAMOUNT
Upper part of eastern flank
Dredge on bottom UTC 17/12/02 1654hrs, lat 41º47.71'S, long 179º27.52'W, depth 1811m
Dredge off bottom UTC 17/12/02 1729hrs, lat 41º47.731'S, long 179º27.772'W, depth 1615m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Uvigerina* (r)	90/10	dominant	glauconite grains (f), volcanic? grains (r)	light olive grey	many fragmented and rare fresh forams; many small globigerinids; ~6 benthic species

STATION 9. SHIPLEY SEAMOUNT
Near top of south flank
Dredge on bottom UTC 17/12/02 1909hrs, lat 41º50.920'S, long 179º31.414'W, depth 1732m
Dredge off bottom UTC 17/12/02 1951hrs, lat 41º50.541'S, long 179º30.955'W, depth 1534m

SR, sediment obtained but no smear slide sample taken

STATION 10. SHIPLEY SEAMOUNT
Eastern slope of easternmost cone on seamount top
Dredge on bottom UTC 17/12/02 2132hrs, lat 41º48.33'S, long 179º29.03'W, depth 1429m
Dredge off bottom UTC 17/12/02 2207hrs, lat 41º48.08'S, long 179º28.9'W, depth 1340m

SR, no sediment obtained

STATION 11. BOLGER SEAMOUNT
Small cone on eastern flank
Dredge on bottom UTC 18/12/02 0516hrs, lat 41º07.03'S, long 179º45.25'W, depth 1940m
Dredge off bottom UTC 18/12/02 0556hrs, lat 41º07.10'S, long 179º45.55'W, depth 1817m

SR, sediment obtained but no smear slide sample taken

STATION 12. MOORE SEAMOUNT
Upper half of northeastern flank
Dredge on bottom UTC 18/12/02 1416hrs, lat 40º24.797'S, long 179º26.010'W, depth 2312m
Dredge off bottom UTC 18/12/02 1526hrs, lat 40º25.032'S, long 179º26.360'W, depth 2078m

SR, sediment obtained but no smear slide sample taken

STATION 13. MOORE SEAMOUNT
Northeastern side of northeastern volcanic cone
Dredge on bottom UTC 18/12/02 1708hrs, lat 40º25.202'S, long 179º26.816'W, depth 1865m
Dredge off bottom UTC 18/12/02 1755hrs, lat 40º25.425'S, long 179º27.216'W, depth 1605m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (c), *Cibicides* (c), echinoid spines (f), siliceous sponge spicules (f)	60/40	very little	(larger) volcanic grains (f), quartz grains (r)	yellowish grey	some fresh forams; ~10 benthic species; single specimen of: *Bulimina* and *Uvigerina*

STATION 14. MOORE SEAMOUNT
Southern flank
Dredge on bottom UTC 18/12/02 2134hrs, lat 40º33.467'S, long 179º30.200'W, depth 2421m
Dredge off bottom UTC 18/12/02 2230hrs, lat 40º33.09'S, long 179º30.05'W, depth 2156m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule fragments (c-a), globigerinids (c), *Cibicides* (f)	60/40	dominant	very small volc.+Mn frags (r), small angular quartz grains (r)	pale olive	few forams; many fragmented and rare fresh forams

STATION 15. MOORE SEAMOUNT
Southernmost cone on plateau
Dredge on bottom UTC 19/12/02 0033hrs, lat 40º26.80'S, long 179º27.81'W, depth 1932m
Dredge off bottom UTC 19/12/02 0134hrs, lat 40º26.71'S, long 179º27.13'W, depth 1651m

SR, no sediment obtained

STATION 16. TV Grab, GTV A
Flat area c. 5nm NE of Moore Seamount
TV-grab over side UTC 19/12/02 0320hrs, lat 40º20.738'S, long 179º23.601'W, depth 3015m, cable 2m
TV-grab on bottom UTC 19/12/02 0426hrs, lat 40º20.746'S, long 179º23.647'W, depth 3015m, cable 2996m
TV-grab closed UTC 19/12/02 0445hrs, lat 40º20.713'S, long 179º23.617'W, depth 3014m, cable 3018m
TV-grab on deck UTC 19/12/02 0600hrs, lat 40º20.723'S, long 179º23.594'W, depth 3014m

GTV A	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule frags (a), globigerinids (f-c)	95/5	dominant	small angular quartz grains (f), very small volc./Mn frags (r)	light olive grey	very few forams; no fresh ones

STATION 17. BOX CORER A
Flat area c. 5nm NE of Moore Seamount
box corer over side UTC 19/12/02 0638hrs, lat 40º20.710'S, long 179º23.625'W, depth 3014m
box corer on bottom UTC 19/12/02 0748hrs, lat 40º20.702'S, long 179º23.677'W, depth 3014m
box corer on deck UTC 19/12/02 0846hrs, lat 40º20.74'S, long 179º23.39'W, depth 3011m

GKG, no sediment obtained

STATION 18. ROWLING SEAMOUNT
Eastern slopes
Dredge on bottom UTC 19/12/02 1754hrs, lat 39º38.176'S, long 179º19.289'E, depth 2753m
Dredge off bottom UTC 19/12/02 1850hrs, lat 39º38.39'S, long 179º19.13'E, depth 2500m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule frags (c), globigerinids (f-c)	95/5	dominant	angular to subangular quartz grains (c) and volc./Mn frags (f)	light olive grey	relatively few forams; no fresh and many fragmented forams; single specimen of *Uvigerina*

STATION 19. ROWLING SEAMOUNT
Small cone from base to top on NE slope
Dredge on bottom UTC 20/12/02 2215hrs, lat 39º33.39'S, long 179º13,45'E, depth 2660m
Dredge off bottom UTC 20/12/02 2248hrs, lat 39º33,65'S, long 179º13,66'E, depth 2512m

SR, no sediment obtained

STATION 20. KIRK SEAMOUNT
Steep WSW flank
Dredge on bottom UTC 20/12/02 0420hrs, lat 39º26.95'S, long 179º50.95'E, depth 2960m
Dredge off bottom UTC 20/12/02 0528hrs, lat 39º26.93'S, long 179º51.42'E, depth 2597m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule frags (f-c), globigerinids (f), *Cibicides* (r)	95/5	dominant	(sub)angular quartz grains (f) and volc./Mn frags (f)	yellowish grey	very few planktic forams; no fresh and many fragmented forams;

STATION 21. KIRK SEAMOUNT
Canyon on steep WSW flank
Dredge on bottom UTC 20/12/02 1024hrs, lat 39º29,14'S, long 179º52,87'E, depth 2886m
Dredge off bottom UTC 20/12/02 1154hrs, lat 39º28.895'S, long 179º53.493'E, depth 2378m

SR, sediment obtained but no smear slide sample taken

STATION 22. KIRK SEAMOUNT
Small cone halfway down steep SSW flank
Dredge on bottom UTC 20/12/02 1400hrs, lat 39º32.110'S, long 179º54.771'E, depth 2918m
Dredge off bottom UTC 20/12/02 1704hrs, lat 39º32.252'S, long 179º54.644'E, depth 3045m (dredge was stuck for 3 hours on bottom)

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule frags (c), globigerinids (c), *Cibicides* (r)	80/20	dominant	angular to subrounded quartz grains (c) and volc./Mn frags (f-c)	light olive grey	no fresh forams;

STATION 23. PALMER SEAMOUNT
W side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 0316hrs, lat 39º32.390'S, long 178º30.747'W, depth 3183m
Dredge off bottom UTC 21/12/02 0408hrs, lat 39º32.291'S, long 178º30.291'W, depth 2974m

SR, no sediment obtained

STATION 24. PALMER SEAMOUNT
NW side of highest small cone W of end of Palmer ridge
Dredge on bottom UTC 21/12/02 1107hrs, lat 39º31.209'S, long 178º34.994'W, depth 3202m
Dredge off bottom UTC 21/12/02 1148hrs, lat 39º31.412'S, long 178º34.698'E, depth 2912m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	siliceous sponge spicule frags (c), globigerinids (c), *Cibicides* (r)	95/5	dominant	small subangular quartz grains (r), very small Mn-frags (r)	yellowish grey	very few fresh and many fragmented forams; many small globigerinids

STATION 25. PALMER SEAMOUNT
NW side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 1405hrs, lat 39º31.641'S, long 178º29.951'W, depth 3134m
Dredge off bottom UTC 21/12/02 1453hrs, lat 39º31.884'S, long 178º29.672'W, depth 2881m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (a), small siliceous sponge spicule frags (f), *Uvigerina* (r), *Orbulina* (r)	90/10	dominant	subangular quartz grains (f) and (larger) volc. frags (f)	yellowish grey	no fresh and relatively many fragmented forams

STATION 26. LANGE SEAMOUNT
Small cone at SW base
Dredge on bottom UTC 22/12/02 0145hrs, lat 39º06.09'S, long 177º30.20'W, depth 3509m
Dredge off bottom UTC 22/12/02 0255hrs, lat 39º06.14'S, long 177º30,49'W, depth 3285m

SR, no sediment obtained

STATION 27. LANGE SEAMOUNT
Small cone on SW edge Lange plateau
Dredge on bottom UTC 22/12/02 0516hrs, lat 39º03.30'S, long 177º28.01'W, depth 2644m
Dredge off bottom UTC 22/12/02 0631hrs, lat 39º02.95'S, long 177º28.10'W, depth 2338m

SR, no sediment obtained

STATION 28. LANGE SEAMOUNT
NE trending canyon on E flank of seamount
Dredge on bottom UTC 22/12/02 1059hrs, lat 39º02.080'S, long 177º15.881'W, depth 3102m
Dredge off bottom UTC 22/12/02 1147hrs, lat 39º02.180'S, long 177º16.354'W, depth 2922m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (a), siliceous sponge spicule frags (f-c), *Cibicides* (f), *Uvigerina* (r)	90/10	equal to biogenic components	subangular quartz grains (f) and (larger) volc. frags (f)	yellowish grey	no fresh and many fragmented forams

STATION 29. KATZ SEAMOUNT
Head of E trending canyon on E side of seamount
Dredge on bottom UTC 22/12/02 1714hrs, lat 38º46.519'S, long 176º57.421'W, depth 3116m
Dredge off bottom UTC 22/12/02 1814hrs, lat 38º46.269'S, long 176º57.699'W, depth 2828m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand/ooze	globigerinids (c-a), *Cibicides* (c-a), siliceous sponge spicule frags (c), *Orbulina* (r)	50/50	less than biogenic components	small subangular quartz grains (f) and (some larger) volc. frags (f)	yellowish grey	some fresh and relatively many fragmented forams; diverse benthic fauna (~15 species), including *Uvigerina* and *Fissurina* ?

STATION 30. MULDOON SEAMOUNT
Small canyon on E side of seamount
Dredge on bottom UTC 23/12/02 0435hrs, lat 38º30.45'S, long 176º34.90'W, depth 3634m
Dredge off bottom UTC 23/12/02 0535hrs, lat 38º30.20'S, long 176º35.22'W, depth 3341m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Cibicides* (f), siliceous sponge spicule frags (f), *Orbulina* (r)	85/15	dominant	small volc./Mn frags (r)	yellowish grey	no fresh and many small fragmented forams; single species of *Animalinoides*

STATION 31. MARSHALL SEAMOUNT
East flank
Dredge on bottom UTC 23/12/02 1938hrs, lat 38º2.14'S, long 177º28.75'W, depth 2974m
Dredge off bottom UTC 23/12/02 2044hrs, lat 38º01.99'S, long 177º29.43'W, depth 2587m

SR, no sediment obtained

STATION 32. KIWI RIDGE A
Top area, 4th small hill from south small canyon
Dredge on bottom UTC 25/12/02 0259hrs, lat 36º18.8'S, long 178º49.2'W, depth 4443m
Dredge off bottom UTC 25/12/02 0416hrs, lat 36º18.743'S, long 178º49.948'W, depth 4133m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram/sponge ooze	siliceous sponge spicule frags (a), globigerinids (c), *Cibicides* (f)	90/10	less than biogenic components	small volc./Mn frags (r)	light olive grey	no fresh and many fragmented forams; relatively few planktic ones; single species of *Uvigerin* a, *Animalinoides*

STATION 33. KIWI RIDGE B
5th cone, upper eastern slope
Dredge on bottom UTC 25/12/02 0715hrs, lat 36º16.93'S, long 178º49.05'W, depth 4470m
Dredge off bottom UTC 25/12/02 0815hrs, lat 36º16.914'S, long 178º49.568'W, depth 4139m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram/sponge ooze	siliceous sponge spicule frags (c), globigerinids (f)	100/0	dominant	none	light olive grey	very few and only fragmented forams

STATION 34. RAPUHIA SCARP A
Steep, single scarp
Dredge on bottom UTC 25/12/02 1439hrs, lat 35º59.497'S, long 178º31.199'W, depth 6182m
Dredge off bottom UTC 25/12/02 1644hrs, lat 36º00.027'S, long 178º31.875'W, depth 5399m

SR, sediment obtained but no smear slide sample taken

STATION 35. MOA SEAMOUNT
SE flank towards top
Dredge on bottom UTC 25/12/02 2223hrs, lat 36º02.05'S, long 178º16.55'W, depth 5918m
Dredge off bottom UTC 26/12/02 0011hrs, lat 36º01.45'S, long 178º17.22'W, depth 5167m

SR, sediment obtained but no smear slide sample taken

STATION 36. RAPUHIA SCARP B
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 0436hrs, lat 36º02.28'S, long 178º28.12'W, depth 6001m
Dredge off bottom UTC 26/12/02 0606hrs, lat 36º02.63'S, long 178º28.69'W, depth 5478m

SR, sediment obtained but no smear slide sample taken

STATION 37. NW RAPUHIA C
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 1112hrs, lat 36º07.242'S, long 178º23.484'W, depth 5868m
Dredge off bottom UTC 26/12/02 1305hrs, lat 36º07.223'S, long 178º23.492'W, depth 5820m

SR, no sediment obtained

STATION 38. NW RAPUHIA D
Few miles SE of DR37
Dredge on bottom UTC 26/12/02 1844hrs, lat 36º22.54'S, long 178º07.787'W, depth 5609m
Dredge off bottom UTC 26/12/02 1956hrs, lat 36º23.12'S, long 178º08.22'W, depth 5028m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	sponge spicule sand	siliceous sponge spicule frags (a)	/	absent	volc./Mn-frags (r), small quartz grains (r)	light olive grey	no identifiable foram frags

STATION 39. NW RAPUHIA E
Ca. 1,5 nm E of DR38
Dredge on bottom UTC 26/12/02 2342hrs, lat 36º23.02'S, long 178º06.60'W, depth 5578m
Dredge off bottom UTC 27/12/02 0124hrs, lat 36º23.60'S, long 178º07.25'W, depth 5017m

SR, no sediment obtained

STATION 40. TUATARA
NW slope, from upper base to top
Dredge on bottom UTC 27/12/02 0708hrs, lat 36º28.03'S, long 177º43.10'W, depth 5076m
Dredge off bottom UTC 27/12/02 0807hrs, lat 36º28.39'S, long 177º42.92'W, depth 4728m

SR, no sediment obtained

STATION 41. SAVAGE A
E side of volcanic ridge marking edge of plateau; northern site
Dredge on bottom UTC 27/12/02 1212hrs, lat 36º38.033'S, long 177º47.502'W, depth 4107m
Dredge off bottom UTC 27/12/02 1328hrs, lat 36º38.173'S, long 177º48.173'W, depth 3555m

SR, no sediment obtained

STATION 42. SAVAGE B
E side of volcanic ridge marking edge of plateau; southern site
Dredge on bottom UTC 27/12/02 1620hrs, lat 36º40.717'S, long 177º46.106'W, depth 3845m
Dredge off bottom UTC 27/12/02 1757hrs, lat 36º40.628'S, long 177º46.729'W, depth 3407m

SR, no sediment obtained

STATION 43. KIORE
NW side
Dredge on bottom UTC 28/12/02 0138hrs, lat 36º38.962'S, long 177º13.008'W, depth 4718m
Dredge off bottom UTC 28/12/02 0329hrs, lat 36º39.364'S, long 177º12.219'W, depth 4184m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	sponge spicule ooze	siliceous sponge spicule frags (a), foram frags (r)	100/0	dominant	angular quartz grains (r)	light olive grey	no identifiable foram frags

STATION 44. SE RAPUHIA A

Rapuhia Scarp, SE Region, Nr 7 of Christmas mappimg, ΔH= 900 m over 1.2 nm

Dredge on bottom UTC 28/12/02 0906hrs, lat 37º07,527'S, long 177º07,864'W, depth 4976m
Dredge off bottom UTC 28/12/02 1034hrs, lat 37º07,993'S, long 177º08,423'W, depth 4280m

SR, no sediment obtained

STATION 45. SE RAPUHIA B

Steepest slope on plateau nose

Dredge on bottom UTC 28/12/02 1615hrs, lat 37º08.946'S, long 176º43.844'W, depth 5039m
Dredge off bottom UTC 28/12/02 1813hrs, lat 37º09.639'S, long 176º44.063'W, depth 4310m

SR, no sediment obtained

STATION 46. PENGUIN A

Southeastern slope from base to top

Dredge on bottom UTC 29/12/02 1843hrs, lat 40º39.956'S, long 173º46.808'W, depth 2999m
Dredge off bottom UTC 29/12/02 1937hrs, lat 40º39.50'S, long 173º47.00'W, depth 2673m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (a), *Cibicides* (c), siliceous sponge spicule frags (f), *Orbulina* (f)	75/25	slightly less than biogenic components	very small angular quartz grains (r)	pale yellowish brown	no fresh and relatively many fragmented forams; ~8 benthic species

STATION 47. PENGUIN B

Northeastern slope, bottom of small valley from base to top

Dredge on bottom UTC 29/12/02 2206hrs, lat 40º37.70'S, long 173º45.05'W, depth 3134m
Dredge off bottom UTC 29/12/02 2320hrs, lat 40º37.75'S, long 173º45.90'W, depth 2757m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Cibicides* (f), *Orbulina* (r)	90/10	dominant	absent	light olive grey	relatively few forams; very rare fresh and many fragmented forams; ~5 benthic species, including *Uvigerina*

STATION 48. POLAR BEAR A

Dredge on bottom UTC 30/12/02 1007hrs, lat 41º31.18'S, long 173º57.08'W, depth 2504m
Dredge off bottom UTC 30/12/02 1140hrs, lat 41º30.77'S, long 173º57.98'W, depth 2082m

SR, sediment obtained but no smear slide sample taken

STATION 49. POLAR BEAR B
Small canyon at western slope; steepest structure
Dredge on bottom UTC 30/12/02 1616hrs, lat 41º27.87'S, long 174º11.89'W, depth 2710m
Dredge off bottom UTC 30/12/02 1809hrs, lat 41º27.81'S, long 174º10.93'W, depth 2072m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), sponge spicule frags (f)	99/1	dominant	absent	yellowish grey	many small and mostly fragmented forams

STATION 50. POLAR BEAR C
Northwestern side, ca. 2.5nm north of DR49
Dredge on bottom UTC 30/12/02 2035hrs, lat 41º25.44'S, long 174º11.34'W, depth 2438m
Dredge off bottom UTC 30/12/02 2138hrs, lat 41º25.43'S, long 174º10.91'W, depth 2135m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
A	foram ooze	globigerinids (c), *Cibicides* (f), sponge spicule frags (r)	80/20	slightly dominant	angular quartz and other grains (r)	yellowish grey	rare fresh and many fragmented forams; ~6 benthic species
B	foram ooze	globigerinids (c), Cibicides (f), sponge spicule frags (r), echinoid spines (r)	80/20	~equal to biogenic components	angular quartz and other grains (r)	light olive grey	many fragmented forams; same composition as SR50-A but coarser grained

STATION 51. TV Grab, GTV A
Plateau of Polar Bear seamount
TV-grab over side UTC 30/12/02 2321hrs, lat 41º26.25'S, long 174º7.08'W, depth 1842m
TV-grab on bottom UTC 30/12/02 2348hrs, lat 41º26.36'S, long 174º7.05'W, depth 1840m
TV-grab closed UTC 30/12/02 0020hrs, lat 41º26.12'S, long 174º7.05'W, depth 1849m
TV-grab of bottom UTC 31/12/02 0021hrs, lat 41º26.12'S, long 174º7.05'W, depth 1849m
TV-grab on deck UTC 31/12/02 0056hrs, lat 41º26.10'S, long 174º7.10'W, depth 1847m

GTV A	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (a), *Cibicides* (f-c), *Orbulina* (f-c), *Bulimina* (r)	55/45	less than biogenic components	glauconite grains (f)	yellowish grey	some fresh (shiny but not translucent) forams; common fragmented forams; ~20 benthic species

STATION 52. TV Grab, GTV A
2.5 nm SW of TV Grab 51 on Polar Bear Plateau
TV-grab over side UTC 31/12/02 0127hrs, lat 41°28.16'S, long 174°10.02'W, depth 1965m
TV-grab on bottom UTC 31/12/02 0202hrs, lat 41°28.13'S, long 174°9.97'W, depth 1957m
TV-grab closed UTC 31/12/02 0212hrs, lat 41°28.04'S, long 174°9.99'W, depth 1959m
TV-grab of bottom UTC 31/12/02 0213hrs, lat 41°28.04'S, long 174°9.99'W, depth 1958m
TV-grab on deck UTC 31/12/02 0255hrs, lat 41°28.10'S, long 174°9.98'W, depth 1958m

	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
GTV A	foram ooze/sand	globigerinids (a), *Cibicides* (f-c), sponge spicule frags (r)	75/25	slightly less than biogenic components	glauconite and other authigenic (bright-green, brownish) minerals (f)	light olive grey	very few fresh and relatively many small planktic forams; ~12 benthic species

STATION 53. Box Corer, GKG
Same site as TV Grab 52
box corer over side UTC 31/12/02 0310hrs, lat 41°28.07'S, long 174°09.99'W, depth 1958m
box corer on bottom UTC 31/12/02 0354hrs, lat 41°28.11'S, long 174°09.97'W, depth 1957m
box corer closed: no data
box corer of bottom UTC 31/12/02 0354hrs, lat 41°28.11'S, long 174°09.97'W, depth 1957m
box corer on deck UTC 31/12/02 0428hrs, lat 41°28.11'S, long 174°09.98'W

GKG, same as GTV A-52

STATION 54 WISHBONE Ridge

Dredge on bottom UTC 31/12/02 0053hrs, lat 40°38,53'S, long 169°44,34'W, depth 3750m
Dredge off bottom UTC 31/12/02 0236hrs, lat 40°38,05'S, long 169°44,96'W, depth 3030m

	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
SR	foram ooze	globigerinids (c), *Orbulina* (r), *Cibicides* (r), echinoid spines (r)	85/15	slightly more than biogenic components	absent	yellowish grey	many fragmented and very few fresh forams; ~7 benthic species

STATION 55 WISHBONE Ridge
Southern part, SE slope, upper part to top
Dredge on bottom UTC 01/01/03 0533hrs, lat 40°45,16'S, long 169°49,68'W, depth 3300m
Dredge off bottom UTC 01/01/03 0723hrs, lat 40°45,12'S, long 169°49,66'W, depth 3340m

SR, no sediment obtained

STATION 56 WISHBONE Ridge
Southwestern corner of Wishbone ridge
Dredge on bottom UTC 01/01/03 0957hrs, lat 40º45,89'S, long 169º50,57'W, depth 3548m
Dredge off bottom UTC 01/01/03 1132hrs, lat 40º45,39'S, long 169º50,70'W, depth 2752m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (a), *Cibicides* (f), sponge spicules frags (r)	85/15	~equal to biogenic components	small subangular quartz grains	yellowish grey	no fresh and relatively many fragmented forams; many small planktic forams; ~7 benthic species

STATION 57 Chicken seamount
Eastern slope
Dredge on bottom UTC 01/01/03 1742hrs, lat 41º03,44'S, long 169º05,34'W, depth 2796m
Dredge off bottom UTC 01/01/03 1900hrs, lat 40º03,49'S, long 169º05,94'W, depth 2390m

SR, sediment obtained but no smear slide sample taken

STATION 58. PUKEKO
Northeastern Corner, east facing slope
Dredge on bottom UTC 02/01/03 0403hrs, lat 41º43.84'S, long 169º17.18'W, depth 3710m
Dredge off bottom UTC 02/01/03 0553hrs, lat 41º43.99'S, long 169º16.99'W, depth 3127m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Cibicides* (r), *Uvigerina* (r), small sponge spicule frags (r)	85/15	dominant	absent	yellowish grey	rare fresh and many fragmented forams; ~7 benthic species

STATION 59. WETA A
Northeastward facing slope of biggest WETA seamount
Dredge on bottom UTC 02/01/03 1426hrs, lat 42º11.93'S, long 168º50.90'W, depth 2907m
Dredge off bottom UTC 02/01/03 1540hrs, lat 42º12.42'S, long 168º51.16'W, depth 2436m

SR, no sediment obtained

STATION 60. WETA B

Another biggish seamount, 4 miles SSW

Dredge on bottom UTC 02/01/03 1807hrs, lat 42º15.51'S, long 168º52.47'W depth 2855m
Dredge off bottom UTC 02/01/03 1853hrs, lat 42º15.71'S, long 168º53.01'W, depth 2570m

SR, no sediment obtained

STATION 61. KAKAPO A

Western seamount flank

Dredge on bottom UTC 03/01/03 0624hrs, lat 43º28.44'S, long 168º37.35'W depth 3174m
Dredge off bottom UTC 03/01/03 0731hrs, lat 43º28.29'S, long 168º36.16'W, depth 2755m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (a), *Cibicides* (f-c), *Orbulina* (f), echinoid spines (r), spiny foram (r, see original drawing)	65/35	less than biogenic components	Mn- + FeO-grains (r)	yellowish grey	some fresher and rel. few fragmented forams; some tests filled with authigenic minerals; ~9 benthic species

STATION 62. TAKAHE

Across nose of northwestern plateau margin

Dredge on bottom UTC 03/01/03 1259hrs, lat 43º03.87'S, long 168º45.60W depth 3102m
Dredge off bottom UTC 03/01/03 1425hrs, lat 43º03.56'S, long 168º44.87'W, depth 2441m

SR, no sediment obtained

STATION 63. KAKAPO B

SE slope

Dredge on bottom UTC 03/01/03 1916hrs, lat 43º29.67'S, long 168º32.51W, depth 3221 m
Dredge off bottom UTC 03/01/03 2037hrs, lat 43º29.42'S, long 168º33.17'W, depth 2830m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Orbulina* (r), *Cibicides* (r)	90/10	~equal to biogenic components	absent	yellowish grey	rare fresh and many fragmented forams; ~3 benthic species

STATION 64. KIEL SEAMOUNT
Rift at eastern slope towards plateau
Dredge on bottom UTC 03/01/03 0211hrs, lat 43º40.64'S, long 168º12.79W, depth 3778 m
Dredge off bottom UTC 03/01/03 0439hrs, lat 43º41.15'S, long 168º13.95'W, depth 3411m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (a), *Orbulina* (c), *Gyroidinoides* (f-c), *Cibicides* (f)	70/30	less than biogenic components	absent	yellowish grey	relatively many fresh looking and fragmented forams (even some planktics); ~9 benthic species, including *Uvigerina*

STATION 65. HAMBURG SEAMOUNT
NW ridge on main S top
Dredge on bottom UTC 04/01/03 16:15hrs, lat 44º31.15'S, long 170º23,39W, depth 3798 m
Dredge off bottom UTC 04/01/03 17:57hrs, lat 44º31,70'S, long 170º2,51'W, depth 3271m

SR, no sediment obtained

STATION 66. ERIK
South eastern slope just below plateau
Dredge on bottom UTC 05/01/03 0817hrs, lat 44º45.60'S, long 172º05.59'W, depth 2926m
Dredge off bottom UTC 05/01/03 0924hrs, lat 44º45.24'S, long 172º05.83'W, depth 2534m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (c), *Cibicides* (r-f), *Orbulina* (r)	80/20	~equal to biogenic components	absent	yellowish grey	rare fresh and very few unfragmented forams; ~5 benthic species, including *Gyroidinoides*

STATION 67. FRANKFURT
Eastern slope, upper base
Dredge on bottom UTC 05/01/03 1830hrs, lat 45º37.37'S, long 172º35.63'W, depth 4030m
Dredge off bottom UTC 05/01/03 1949hrs, lat 45º36.94'S, long 172º36.22'W, depth 3560m

SR, sediment obtained but no smear slide sample taken

STATION 68. STUTTGART
Top
TV-grab over side UTC 6/1/03 0140hrs, lat 45º29.368'S, long 173º22.568'W, depth 3940m, cable 0m
TV-grab on bottom UTC 6/1/03 0245hrs, lat 45º29.349'S, long 173º22.690'W, depth 3946m, cable 3927m
TV-grab closed UTC 6/1/03 0318hrs, lat 45º29.290'S, long 173º22.744'W, depth 3951m, cable 3956m
TV-grab on deck UTC 6/1/03 0440hrs, lat 45º29.326'S, long 173º22.748'W, depth 3947m, cable 0m

GTV A	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram ooze	globigerinids (f-c), *Cibicides* (r)	80/20	clearly dominant	absent	yellowish grey	very few forams; no fresh and rare unfragmented forams; ~4 benthic species, including U*vigerina, Orbulina*

STATION 69. STUTTGART
Top
box corer over side UTC 6/1/03 0504hrs, lat 45º29.300'S, long 173º22.738'W, depth 3948m, cable 0m
box corer on bottom UTC 6/1/03 0620hrs, lat 45º29.309'S, long 173º22.722'W, depth 3951m, cable 3948m
box corer on deck UTC 6/1/03 0725hrs, lat 45º29.223'S, long 173º22.392'W, depth 3941m, cable 0m

GKG empty, did not operate properly, no sediment obtained

STATION 70. STUTTGART A
Southeastern slope
Dredge on bottom UTC 06/01/03 0939hrs, lat 45º29.32'S, long 173º14.20'W, depth 4591m
Dredge off bottom UTC 06/01/03 1107hrs, lat 45º28.95'S, long 173º14.55'W, depth 3956m

SR, no sediment obtained

STATION 71. STUTTGART B
Southeastern corner, upper slope
Dredge on bottom UTC 06/01/03 1352hrs, lat 45º29.57'S, long 173º15.64'W, depth 4240m
Dredge off bottom UTC 06/01/03 1506hrs, lat 45º29.07'S, long 173º15.71'W, depth 3654m

SR, no sediment obtained

STATION 72 MÜNCHEN
Valley at upper eastern slope
Dredge on bottom UTC 07/01/03 0025hrs?, lat 44º42.86'S, long 174º02.80'W, depth 2286m
Dredge off bottom UTC 07/01/03 0127hrs, lat 44º42.99'S, long 174º03.60'W, depth 1979m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (a), *Cibicides* (c), *Gyroidinoides* (f), *Orbulina* (r)	60/40	slightly less than biogenic components	brownish authigenic grains	yellowish grey	some fresh and relatively few fragmented forams; ~20 benthic species, including *Ehrenbergina* ; one ostracod

STATION 73. WESTERN UPRISING
Northeastern shallow slope
Dredge on bottom UTC 07/01/03 0704hrs, lat 44º12.99'S, long 174º28.22'W, depth 965m
Dredge off bottom UTC 07/01/03 0811hrs, lat 44º13.22'S, long 174º28.90'W, depth 874m (posn when stuck dredge was freed)

SR, no sediment obtained

STATION 74. CHAPMANS HILL
Northeastern slope of northern peak
Dredge on bottom UTC 07/01/03 1053hrs, lat 44º09.08'S, long 174º32.85'W, depth 871m
Dredge off bottom UTC 07/01/03 1154hrs, lat 44º09.40'S, long 174º33.02'W, depth 610m

SR, no sediment obtained

STATION 75. UNLUCKY HILL
SW slope
Dredge on bottom UTC 07/01/03 1810hrs, lat 44º21.87'S, long 174º58.22'W, depth 742m
Dredge off bottom UTC 07/01/03 1841hrs, lat 44º21.649'S, long 174º57.977'W, depth 457m

SR, no sediment obtained

STATION 76. HOWSON A
Northern edge of main top
Dredge on bottom UTC 07/01/03 2349hrs, lat 43º56.12'S, long 175º18.16'W, depth 134m
Dredge off bottom UTC 08/01/03 0005hrs, lat 43º56.216'S, long 175º18.202'W, depth 98m

SR, no sediment obtained

STATION 77. HOWSON B
Northeastern edge of main top
Dredge on bottom UTC 08/01/03 0050hrs, lat 43º56.369'S, long 175º17.618'W, depth 130m
Dredge off bottom UTC 08/01/03 0116hrs, lat 43º56.357'S, long 175º17.676'W, depth 120m

SR, no sediment obtained

STATION 78. HOWSON C
North side of small cone to east of main top
Dredge on bottom UTC 08/01/03 0145hrs, lat 43º56.656'S, long 175º17.296'W, depth 127m
Dredge off bottom UTC 08/01/03 0222hrs, lat 43º56.690'S, long 175º17.308'W, depth 104m

SR, no sediment obtained

STATION 79. HOWSON D
NW side of small cone to SW of main top
Dredge on bottom UTC 08/01/03 0308hrs, lat 43º57.195'S, long 175º18.889'W, depth 112m
Dredge off bottom UTC 08/01/03 0322hrs, lat 43º57.262'S, long 175º18.867'W, depth 103m

SR, no sediment obtained

STATION 80. CHARLTON A
Northern dredge on slope
Dredge on bottom UTC 08/01/03 0537hrs, lat 44º11.634'S, long 175º27.948'W, depth 253m
Dredge off bottom UTC 08/01/03 0604hrs, lat 44º11.733'S, long 175º27.889'W, depth 161m

SR, no sediment obtained

STATION 81. CHARLTON B
Southern dredge near top of cone
Dredge on bottom UTC 08/01/03 0723hrs, lat 44º13.78'S, long 175º27.10'W, depth 124m
Dredge off bottom UTC 08/01/03 0747hrs, lat 44º13.86'S, long 175º27.10'W, depth 101m

SR, sediment obtained but no smear slide sample taken

STATION 82. HICKS
Southwestern slope
Dredge on bottom UTC 08/01/03 1040hrs, lat 44º27.75'S, long 175º21.19'W, depth 515m
Dredge off bottom UTC 08/01/03 1100hrs, lat 44º27.70'S, long 175º21.06'W, depth 386m

SR, no sediment obtained

STATION 83. FBI
South slope of southern cone
Dredge on bottom UTC 08/01/03 1336hrs, lat 44º40.833'S, long 175º12.754'W, depth 1024m
Dredge off bottom UTC 08/01/03 1423hrs, lat 44º40.517'S, long 175º12.756'W, depth 755m

SR, sediment obtained but no smear slide sample taken

STATION 84. GORE
SE flank
Dredge on bottom UTC 08/01/03 1807hrs, lat 44º36.673'S, long 175º45.024'W, depth 1192m
Dredge off bottom UTC 08/01/03 1903hrs, lat 44º36.38'S, long 175º45.26'W, depth 884m

SR, sediment obtained but no smear slide sample taken

STATION 85. MONKHOUSE
~ 2.5 nm east of Monkhouse position, base of ridge-like structure
Dredge on bottom UTC 09/01/03 0216hrs, lat 44º39.75'S, long 176°17.35'W, depth 740m
Dredge off bottom UTC 09/01/03 0240hrs, lat 44º39.78'S, long 176º18.10'W, depth 540m (position when stuck dredge became free)

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (c), echinoid spines (c), *Cibicides* (c), bioclasts (r)	60/40	quite coarse, ~equal to biogenic components	lithic + Mn-frags (f)	greyish olive	relatively few fragmented and relatively many fresh forams; ~15 benthic species including U*vigerina, Gyroidinoides*

STATION 86. JONES
South-facing nose dredged in NE direction
Dredge on bottom UTC 09/01/03 0757hrs, lat 44º35.835'S, long 176°31.973'W, depth 563m
Dredge off bottom UTC 09/01/03 0824hrs, lat 44º35.787'S, long 176º30.668'W, depth 421m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	bioclast/coral rubble	coral debris (c-a), echinoid spines (c), bioclasts (f-c), globigerinids (f), *Cibicides* (r), *Orbulina* (r)	55/45	very litle	lithic + phosphatized frags (f)	greyish olive	relatively few forams; rel. many unfragmented and few fresh forams; ~8 benthic species including *Fissurina, Gyroidinoides*

STATION 87. PERRY
SE flank of table mountain
Dredge on bottom UTC 09/01/03 1145hrs, lat 44º38.581'S, long 176°49.498'W, depth 684m
Dredge off bottom UTC 09/01/03 1232hrs, lat 44º38.376'S, long 176º49.121'W, depth 511m

SR, sediment obtained but no smear slide sample taken

STATION 88. THOMPSON
SW corner, steepest slope
Dredge on bottom UTC 09/01/03 1436hrs, lat 44º44.268'S, long 176°48.072'W, depth 988m
Dredge off bottom UTC 09/01/03 1545hrs, lat 44º43.932'S, long 176º47.751'W, depth 733m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (c), echinoid spines (c), bioclasts (c), *Cibicides* (r), *Orbulina* (r), reworked limestone clasts (r)	60/40	less than biogenic components	lithic, glauconite + Mn-fragments (f)	greyish olive	some fresh (also planktic) forams; relatively few fragmented forams; ~14 benthic species including *Lagena* , *Lenticulina* , *Melonis* , *Ehrenbergina*

STATION 89. CLERKE A
SE slope
Dredge on bottom UTC 10/01/03 0231hrs, lat 43º52.375'S, long 177°07.473'W, depth 127m
Dredge off bottom UTC 10/01/03 0248hrs, lat 43º52.327'S, long 177º07.416'W, depth 84m

SR, no sediment obtained

STATION 90. CLERKE B
Cone or ridge structure S of DR89, SE slope
Dredge on bottom UTC 10/01/03 0347hrs, lat 43º52.877'S, long 177°07.563'W, depth 156m
Dredge off bottom UTC 10/01/03 0432hrs, lat 43º52.847'S, long 177º07.522'W, depth 148m

dredge was lost, no sediment obtained

STATION 91. MANLEY
SW flank
Dredge on bottom UTC 10/01/03 0951hrs, lat 43º22.090'S, long 177°22.456'W, depth 204m
Dredge off bottom UTC 10/01/03 1019hrs, lat 43º22.023'S, long 177º22,370 'W, depth 189m

SR, no sediment obtained

STATION 92
plain area on Chatham Rise, "carbonate mound" WNW of Chatham Islands
TV-grab over side UTC 10/1/03 2136hrs, lat 43º3,645'S, long 178º38,904'W, depth 527m, cable 0m
TV-grab on bottom UTC 10/1/03 2156hrs, lat 43º3,665'S, long 178º39,006'W, depth 528m, cable 517m
TV-grab closed UTC 10/1/03 2205hrs, lat 43º3,659'S, long 178º39,058'W, depth 526m, cable 535m
TV-grab on deck UTC 10/1/03 2221hrs, lat 43º03,60'S, long 178º39,118'W, depth 527m, cable 0m

GTV A, sediment obtained but no smear slide sample taken

STATION 93
plain area on Chatham Rise, "carbonate mound" WNW of Chatham Islands
box corer over side UTC 10/1/03 2250hrs, lat 43º03,68'S, long 178º39,06'W, depth 527m, cable 0m
box corer on bottom UTC 10/1/03 2305hrs, lat 43º0368'S, long 178º39,06'W, depth 527m, cable 528m
box corer on deck UTC 10/1/03 2318hrs, lat 43º3,696'S, long 178º39,006'W, depth 526m, cable 0m

GKG	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram/sponge ooze	siliceous sponge spicule fragments (c-a), globigerinids (c), *Gyroidinoides* (r-f), *Cibicides* (r), echinoid spines (r)	80/20	~equal to biogenic components	glauconite grains (c)	pale olive	rare fresh and many fragmented forams; many small globigerinids; ~7 benthic species

STATION 94.MATHESON Bank
soouthern margin
Dredge on bottom UTC 11/01/03 1403hrs, lat 44º00,35'S, long 179°12,84'W, depth 289m
Dredge off bottom UTC 11/01/03 1416hrs, lat 44º00,346'S, long 179º12,958 'W, depth 285m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	foram sand	globigerinids (c-a), echinoid spines (f), ostracods (r-f), *Cibicides* (r), *Orbulina* (r), *Uvigerina* (r). *Notorotalia* (r), *Lagena* (r)	60/40	very little	dark green (pyroxene?), dark grey, brownish and quartz grains grains (c-a)	pale olive	relatively many fresh forams; few fragmented forams; ~27 benthic species

STATION 95.MATHESON Bank
southern margin
Dredge on bottom UTC 11/01/03 1504hrs, lat 43º59,926'S, long 179°14,848'W, depth 272m
Dredge off bottom UTC 11/01/03 1540hrs, lat 43º59,751'S, long 179º14,868 'W, depth 252m

SR, no sediment obtained

STATION 96. SILKE
Easternmost small cone of group, northern slope.
Dredge on bottom UTC 12/01/03 1743hrs, lat 44º03,058'S, long 176°27,666'E, depth 605m
Dredge off bottom UTC 12/01/03 1831hrs, lat 44º03,263'S, long 176º27,608'E, depth 405m

SR	TYPE	BIOGENIC COMPONENTS	P/B FORAM RATIO	MUD MATRIX	ABIOGENIC COMPS	COLOUR	REMARKS
	bioclastic sand	bioclastics (f-c), echinoid spines (f-c),globigerinids (c-a)	80/20	very little	glauconite grains and foram infillings (c), dark green (pyroxene?) and dark grey mineral grains (f), small mica plates (f), quartz grains (r)	pale olive	few forams; many fragmented forams yet some fresh ones; ~5 benthic species

STATION 97. ORTON
Small cone at base of SE flank of Veryan Bank
Dredge on bottom UTC 12/01/03 2250hrs, lat 44º21.02'S, long 176°11.40'E, depth 575m
Dredge off bottom UTC 12/01/03 2334hrs, lat 44º21.15'S, long 176º11.16'E, depth 400m

SR, no sediment obtained

STATION 98. GATHREY
Small cone at base of S flank of Veryan Bank
Dredge on bottom UTC 13/01/03 0214hrs, lat 44º24.135'S, long 175°55.220'E, depth 490m
Dredge off bottom UTC 13/01/03 0351hrs, lat 44º24.18'S, long 175º55.10'E, depth 420m (best estimate, dredge stuck)

SR, sediment obtained but no smear slide sample taken

STATION 99. ANJA VULKAN
300m high cone 5nm SW of Gathrey
Dredge on bottom UTC 13/01/03 0619hrs, lat 44º30.479'S, long 175°51.062'E, depth 731m
Dredge off bottom UTC 13/01/03 0721hrs, lat 44º30.512'S, long 175º50.955'E, depth 644m

SR, sediment obtained but no smear slide sample taken

STATION 100. YOUNG NICK (Herzer et al knoll A)
NE part
Dredge on bottom UTC 13/01/03 1809hrs, lat 44º48.79'S, long 174°56.31'W, depth 896m
Dredge off bottom UTC 13/01/03 1856hrs, lat 44º49.07'S, long 174º56.41'W, depth 680m

SR, sediment obtained but no smear slide sample taken

STATION 101. JORDAN
300m high cone 4 nm NW of Young Nick
Dredge on bottom UTC 13/01/03 2023hrs, lat 44º45.326'S, long 174°52.612'E, depth 853m
Dredge off bottom UTC 13/01/03 2108hrs, lat 44º45.702'S, long 174º52.793'E, depth 610m

SR, sediment obtained but no smear slide sample taken

STATION 102. READING
Small cone, 1.5 nm W of Jordan
Dredge on bottom UTC 13/01/03 2249hrs, lat 44º45.85'S, long 174°51.04'E, depth 821m
Dredge off bottom UTC 13/01/03 2325hrs, lat 44º45.135'S, long 174º51.024'E, depth 631m

SR, sediment obtained but no smear slide sample taken

STATION 103. URRY PLAIN
Plain area among eastern Urry Knolls
TV-grab over side UTC 14/1/03 0010hrs, lat 44º45.273'S, long 174º49.117'W, depth 885m, cable 0m
TV-grab on bottom UTC 14/1/03 0023hrs, lat 44º45.314'S, long 174º49.086'W, depth 885m, cable 872m
TV-grab closed UTC 14/1/03 0040hrs, lat 44º45.211'S, long 174º49.065'W, depth 885m, cable 876m
TV-grab on deck UTC 14/1/03 0057hrs, lat 44º45.271'S, long 174º49.105'W, depth 886m, cable 0m

GTV A, sediment obtained but no smear slide sample taken

STATION 104. FORWOOD
Prominent cone, central part of Urry Knolls
Dredge on bottom UTC 14/01/03 0406hrs, lat 44º45.90'S, long 174°23.907'E, depth 770m
Dredge off bottom UTC 14/01/03 0502hrs, lat 44º46.24'S, long 174º23.902'E, depth 594m

SR, sediment obtained but no smear slide sample taken

STATION 105. BOOTIE
Prominent cone, central part of Urry Knolls. (Herzer et al knoll C)
Dredge on bottom UTC 14/01/03 0739hrs, lat 44º36.121'S, long 174°14.77'E, depth 719m
Dredge off bottom UTC 14/01/03 0815hrs, lat 44º36.32'S, long 174º14.80'E, depth 597m

SR, sediment obtained but no smear slide sample taken

SO168 Biological Sampling

Abbreviations: n=number of collected specimens, FIX= fixation, F= 4% Formalin, EtOH= 100% Ethanol.
The numbers 2, 5, 50, 100, 200, 500 and 1000 give the size of the vials in Milliliter.

STATION 1. MOUNT SPONG
SW inner wall of crater
Dredge on bottom UTC 14/12/02 1050hrs, lat 39°48.814'S, long 167°14.291'E, depth 1076m
Dredge off bottom UTC 14/12/02 1120hrs, lat 39°48.803'S, long 167°14.013'E, depth 972m
no sediment, no macrofauna

STATION 2. MOUNT SPONG
W inner wall of crater
Dredge on bottom UTC 14/12/02 1237hrs, lat 39°48.502'S, long 167°14.397'E, depth 1055m
Dredge off bottom UTC 14/12/02 1304hrs, lat 39°48.523'S, long 167°14.196'E, depth 957m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	>10		x							F	
	Porifera	>10		x							F	mainly Hexactinellida??
	Anthozoa, Hexacor., Scleractinia	10		x							F	partly dead corals, label: Anthozoa?
	Polychaeta	1		x							F	
	Bryozoa	4		x							F	
	Brachiopoda, *Laqueus* sp.	2				x					EtOH	1 specimen ventral valve only

STATION 3. GRAVEYARD SEAMOUNT
NE flank
Dredge on bottom UTC 16/12/02 2048hrs, lat 42°45.088'S, long 179°59.092'W, depth 1018m
Dredge off bottom UTC 16/12/02 2118hrs, lat 42°45.094'S, long 179°59.229'W, depth 976m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	>10	x								F	
	Porifera	>20				x					F	mainly Hexactinellida?
	Porifera	>10			x						F	mainly Hexactinellida?
	Anthozoa, Hexacor., Actiniaria	6			x						F	
	Anthozoa, Hexacor., Scleractinia	6			x						F	1 large coral, broken
	Anthozoa, Hexacoral.?	2			x						F	
	Scyphozoa, Coronata	2		x							F	
	Hydrozoa, Hydroida	1		x							F	
	Polychaeta	6				x					F	Several pieces of 1 large Nereid, Polynoid scales
	Mollusca, Gastropoda	2	x								F	dead shells
	Mollusca, Pteropoda	1	x								F	dead shell
	Mollusca, Polyplacophora	1			x						F	
	Crustacea, Isopoda	1	x								F	
	Bryozoa	>30			x						F	encrusting and branched colonies
	Bryozoa?	1			x						F	large, branched, no taxon name on label
	Brachiopoda	2	x								F	juvenile *Novocrania*
	Brachiopoda	1		x							F	dead, fossil?, dried
	Brachiopoda	1			x						F	*Liothyrella* , dead shell
	Echinodermata, Crinoida	4			x						F	Comatulidae
	Echinodermata, Asteroida	1			x						F	
	Tunicata, Botrylloidea?	14			x						F	
	?	>5		x							F	soft, yellowish tissue
	fossil corals	3										symbiontic form of Madrepora

STATION 4. GRAVEYARD SEAMOUNT
Top
Dredge on bottom UTC 16/12/02 2237hrs, lat 42°45.48'S, long 179°59.36'W, depth 807m
Dredge off bottom UTC 16/12/02 2259hrs, lat 42°45.650'S, long 179°59.365'W, depth 773m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	>10	x								F	
	Porifera	>10		x							F	mainly Hexactinellida???
	Porifera	1		x							F	Demospongiae
	Porifera	1							x		F	
	Anthozoa, Hexacor., Actiniaria	1	x								F	
	Anthozoa,Octocor., Alcyonaria?	1		x							F	1 colony, pale red, label: Hydrozoa?
	Hydrozoa, Hydroida	4		x							F	2 different species
	Polychaeta	1	x								F	
	Mollusca, Bivalvia, Arcidae	2		x							F	
	Crustacea, Galatheidae	1		x							F	
	Bryozoa	>20		x							F	
	Bryozoa or Hydrozoa?	6		x							F	
	Echinodermata, Ophiuroida	1	x								F	central disc and 2 arms

STATION 5. MORGUE SEAMOUNT
Eastern base
Dredge on bottom UTC 17/12/02 0021hrs, lat 42º42.687'S, long 179º57.049'W, depth 1185m
Dredge off bottom UTC 17/12/02 0132hrs, lat 42º42.830'S, long 179º57.182'W, depth 1025m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	6	x								F	
	Porifera	>20		x							F	mainly Hexactinellida??
	Porifera	6			x						F	2 possibly holdfasts of cnidarians
	Anthozoa, Hexacor., Scleractinia	12+					x				F	partly dead corals
	Anthozoa, Hexacor., Actiniaria	~20		x							F	
	Scyphozoa, Coronata	4	x								F	
	Hydrozoa, Hydroida	5		x							F	
	Polychaeta	~20			x						F	also with polynoid scales
	Mollusca, Aplacophora	1	x								F	
	Mollusca, Polyplacophora	1	x								F	
	Crustacea, Copepoda?	1	x								F	
	Crustacea, Cirripedia, Thoracica	1	x								F	dead shell
	Crustacea, Amphip., Caprellidae	1	x								F	possibly from ship hull
	Bryozoa	>40			x						F	encrusting and branched col.
	Brachiopoda	1		x							EtOH	juvenile terebratulid
	Echinodermata, Asteroida	1			x						F	same as DR-3
	Echinodermata, Holothurioida?	1	x								F	possibly an echiurid worm
	Echinodermata, Ophiuroida	1			x						F	
	Tunicata	7		x							F	
	Tunicata, Pyrosomida	1						x			F	plankton, pale red
	?	13			x						F	part of Polyplacophora?
Meiofauna	Nematoda	29									F	
	Copepoda	8									F	
	Crustacea	2									F	
	Annelida	6									F	
	Kinorhyncha	1									F	
	Loricifera	1									F	
fossil corals		3										symbiontic form of Madrepora

STATION 6. HEADSTONE SEAMOUNT
East side
Dredge on bottom UTC 17/12/02 0301hrs, lat 42º40.6'S, long 179º57.0'W, depth 1261m
Dredge off bottom UTC 17/12/02 0345hrs, lat 42º40.690'S, long 179º57.362'W, depth 1173m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	~10	x								F	SR
	Porifera	1	x								F	SR
	Anthozoa, Hexacor., Scleractinia	~15			x						F	SR, dead pieces of corals
	Polychaeta, Serpulidae	1	x								F	
	Mollusca, Gastropoda	3			x						F	SR, dead shells
	Crustacea, Amphipoda	1	x								F	possibly from ship hull
	Crustacea, Ostracoda	7	x								F	SR
Meiofauna	Nematoda	51									F	
	Copepoda	14									F	
	Crustacea	8									F	
	Ostracoda	1									F	
	Annelida	7									F	
	unidentified worm-like organisms	3									F	
	Holothurioida	1									F	

STATION 7. SHIPLEY SEAMOUNT
Middle part of eastern flank
Dredge on bottom UTC 17/12/02 1409hrs, lat 41º49.893'S, long 179º28.195'W, depth 2097m
Dredge off bottom UTC 17/12/02 1517hrs, lat 41º49.491'S, long 179º28.512'W, depth 1773m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	149									F	
	Copepoda	11									F	
	Crustacea	9									F	
	Annelida	10									F	

STATION 8. SHIPLEY SEAMOUNT
Upper part of eastern flank
Dredge on bottom UTC 17/12/02 1654hrs, lat 41º47.71'S, long 179º27.52'W, depth 1811m
Dredge off bottom UTC 17/12/02 1729hrs, lat 41º47.731'S, long 179º27.772'W, depth 1615m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	38									F	
	Copepoda	6									F	
	Ostracoda	1									F	
	Annelida	1									F	
	Kinorhyncha	1									F	

STATION 9. SHIPLEY SEAMOUNT
Near top of south flank
Dredge on bottom UTC 17/12/02 1909hrs, lat 41º50.920'S, long 179º31.414'W, depth 1732m
Dredge off bottom UTC 17/12/02 1951hrs, lat 41º50.541'S, long 179º30.955'W, depth 1534m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	>10	x								F	benthic forams
	Porifera	5		x							F	
	Porifera?	17	x								F	on Mn-crust
	Anthozoa, Octocorallia	1						x			F	orig. colour: bright orange
	Anthozoa, Hexacor., Scleractinia	1	x								F	dead
	Hydrozoa	3		x							F	
	Hydrozoa?	1	x								F	
	Cnidaria, Scyphozoa, Coronata	3	x								F	
	Polychaeta	2	x								F	1 spionid, 1 serpulid
	Crustacea, Ostracoda	1	x								F	
	Bryozoa	~20	x								F	
	Brachiopoda	1		x							EtOH	terebratulid, *Abyssothyris* ?
	Tunicata	2	x								F	covered with forams
Meiofauna	Nematoda	37									F	
	Copepoda	6									F	
	Crustacea	2									F	
	Annelida	4									F	

STATION 10. SHIPLEY SEAMOUNT
Eastern slope of easternmost cone on seamount top
Dredge on bottom UTC 17/12/02 2132hrs, lat 41º48.33'S, long 179º29.03'W, depth 1429m
Dredge off bottom UTC 17/12/02 2207hrs, lat 41º48.08'S, long 179º28.9'W, depth 1340m
no sediment, no macrofauna

STATION 11. BOLGER SEAMOUNT
Small cone on eastern flank
Dredge on bottom UTC 18/12/02 0516hrs, lat 41º07.03'S, long 179º45.25'W, depth 1940m
Dredge off bottom UTC 18/12/02 0556hrs, lat 41º07.10'S, long 179º45.55'W, depth 1817m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	2		x							F	from SR
	Anthozoa, Hexacor., Actiniaria	6		x							F	
	Sipuncula	1		x							F	
	Crustacea, Galatheidae	1			x						F	
	Brachiopoda	1		x							F	part of a ventr. valve, from SR
Meiofauna	Nematoda	41									F	
	Copepoda	6									F	
	Annelida	6									F	
	unidentified worm-like organisms	65									F	
	Kinorhyncha	2									F	

STATION 12. MOORE SEAMOUNT
Upper half of northeastern flank
Dredge on bottom UTC 18/12/02 1416hrs, lat 40º24.797'S, long 179º26.010'W, depth 2312m
Dredge off bottom UTC 18/12/02 1526hrs, lat 40º25.032'S, long 179º26.360'W, depth 2078m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1	x								F	
	Bryozoa	4	x								F	
Meiofauna	Nematoda	189									F	
	Copepoda+B243	20									F	
	Crustacea	2									F	
	Annelida	9									F	
	Sipuncula	1									F	
	unidentified worm-like organisms	17									F	
	Komokiacea?	2									F	

STATION 13. MOORE SEAMOUNT
Northeastern side of northeastern volcanic cone
Dredge on bottom UTC 18/12/02 1708hrs, lat 40º25.202'S, long 179º26.816'W, depth 1865m
Dredge off bottom UTC 18/12/02 1755hrs, lat 40º25.425'S, long 179º27.216'W, depth 1605m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	4			x						F	
	Anthozoa, Octocorallia	1							x		F	orig. colour: pink
	Anthozoa, Hexacor., Actiniaria	2	x								F	
	Anthozoa, Hexacor., Scleractinia	4	x								F	one specimen alive
	Scyphozoa, Coronata	1	x								F	
	Hydrozoa, Hydroida	1	x								F	
	Polychaeta	6		x							F	partly tubes with forams
	Mollusca, Gastropoda	1	x								F	dead shell
	Crustacea, Amphipoda	1		x							F	Corophiidae?
	Bryozoa	4	x								F	
	Brachiopoda	2	x								F	1 *Pelagodiscus* ? 1 *Gwynia* ?
	Echinodermata, Holothurioida	1	x								F	flattened, chiton-like, < 1cm
	Echinodermata, Ophiuroida	1					x					orig. colour: dark brownish red
	Tunicata	3		x							F	2 species
Meiofauna	Nematoda	43									F	
	Copepoda	5									F	
	Crustacea	1									F	
	Ostracoda	1									F	
	Annelida	9									F	
	unidentified worm-like organisms	8									F	
	unidentified organisms	1									F	
fossil corals				x								solitary; colonial (symbiontic form of Madrepora)

STATION 14. MOORE SEAMOUNT
Southern flank
Dredge on bottom UTC 18/12/02 2134hrs, lat 40º33.467'S, long 179º30.200'W, depth 2421m
Dredge off bottom UTC 18/12/02 2230hrs, lat 40º33.09'S, long 179º30.05'W, depth 2156m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	17										
	Copepoda	2										
	Annelida	5										
	unidentified worm-like organisms	4										
	Bivalvia	1										
	Insecta	1										

STATION 15. MOORE SEAMOUNT
Southernmost cone on plateau
Dredge on bottom UTC 19/12/02 0033hrs, lat 40º26.80'S, long 179º27.81'W, depth 1932m
Dredge off bottom UTC 19/12/02 0134hrs, lat 40º26.71'S, long 179º27.13'W, depth 1651m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	2	x								F	
	Cnidaria, Hexacor., Actiniaria	4	x								F	
	Polychaeta	1	x								F	chitinous tube
	Bryozoa	3	x								F	two species

STATION 16. TV GRAB A
Flat area c. 5nm NE of Moore Seamount
TV-grab over side UTC 19/12/02 0320hrs, lat 40º20.738'S, long 179º23.601'W, depth 3015m, cable 2m
TV-grab on bottom UTC 19/12/02 0426hrs, lat 40º20.746'S, long 179º23.647'W, depth 3015m, cable 2996m
TV-grab closed UTC 19/12/02 0445hrs, lat 40º20.713'S, long 179º23.617'W, depth 3014m, cable 3018m
TV-grab on deck UTC 19/12/02 0600hrs, lat 40º20.723'S, long 179º23.594'W, depth 3014m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera, Hexactinellida*	4					x				F	dead
	Porifera?	10				x					F	dead
	Cnidaria, Coronata	6				x					-	in seawater, hopefully alive!
	Cnidaria, Coronata	3	x								F	epibenthic on *
	Polychaeta	4	x								F	epibenthic on *, tubes
	Bryozoa	3	x								F	epibenthic on *
Meiofauna	Nematoda	675									F	
	Copepoda	16									F	
	Annelida	19									F	
	unidentified worm-like organisms	16									F	
	Loricifera	1									F	

STATION 17. BOX CORER A
Flat area c. 5nm NE of Moore Seamount
box corer over side UTC 19/12/02 0638hrs, lat 40º20.710'S, long 179º23.625'W, depth 3014m
box corer on bottom UTC 19/12/02 0748hrs, lat 40º20.702'S, long 179º23.677'W, depth 3014m
box corer on deck UTC 19/12/02 0846hrs, lat 40º20.74'S, long 179º23.39'W, depth 3011m
no sediment

STATION 18. ROWLING SEAMOUNT
Eastern slopes
Dredge on bottom UTC 19/12/02 1754hrs, lat 39º38.176'S, long 179º19.289'E, depth 2753m
Dredge off bottom UTC 19/12/02 1850hrs, lat 39º38.39'S, long 179º19.13'E, depth 2500m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	76									F	
	Copepoda	10									F	
	Annelida	6									F	
	Pogonophora	3									F	tubes only
	unidentified worm-like organisms	2									F	
	unidentified organisms	2									F	

STATION 19. ROWLING SEAMOUNT
Small cone from base to top on NE slope
Dredge on bottom UTC 20/12/02 2215hrs, lat 39º33.39'S, long 179º13,45'E, depth 2660m
Dredge off bottom UTC 20/12/02 2248hrs, lat 39º33,65'S, long 179º13,66'E, depth 2512m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	4			x						F	Hexactinellida??
	Anthozoa, Octocorallia	1		x							F	2 pieces of a colony
	Hydrozoa, Hydroida	1	x								F	
	Bryozoa	6	x								F	

STATION 20. KIRK SEAMOUNT
Steep WSW flank
Dredge on bottom UTC 20/12/02 0420hrs, lat 39º26.95'S, long 179º50.95'E, depth 2960m
Dredge off bottom UTC 20/12/02 0528hrs, lat 39º26.93'S, long 179º51.42'E, depth 2597m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	57									F	
	Copepoda	11									F	
	Crustacea	4									F	
	Ostracoda	1									F	
	Annelida	8									F	
	unidentified worm-like organisms	2									F	
	Tardigrada	1									F	

STATION 21. KIRK SEAMOUNT
Canyon on steep WSW flank
Dredge on bottom UTC 20/12/02 1024hrs, lat 39º29,14'S, long 179º52,87'E, depth 2886m
Dredge off bottom UTC 20/12/02 1154hrs, lat 39º28.895'S, long 179º53.493'E, depth 2378m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	3		x							F	Hexactinellida??
	Bryozoa	7	x								F	
Meiofauna	Nematoda	81									F	
	Copepoda	10									F	
	Annelida	8									F	
	unidentified worm-like organisms	7									F	

STATION 22. KIRK SEAMOUNT
Small cone halfway down steep SSW flank
Dredge on bottom UTC 20/12/02 1400hrs, lat 39º32.110'S, long 179º54.771'E, depth 2918m
Dredge off bottom UTC 20/12/02 1704hrs, lat 39º32.252'S, long 179º54.644'E, depth 3045m (dredge was stuck for 3 hours on bottom)
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	3	x								F	Hexactinellida??
	Hydrozoa, Hydroida	1	x								F	
	Bryozoa	1	x								F	
Meiofauna	Nematoda	17									F	
	Copepoda	1									F	
	Annelida	1									F	

STATION 23. PALMER SEAMOUNT
W side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 0316hrs, lat 39º32.390'S, long 178º30.747'W, depth 3183m
Dredge off bottom UTC 21/12/02 0408hrs, lat 39º32.291'S, long 178º30.291'W, depth 2974m
no sediment, large block of Mn

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	>10			x						F	at least 4 species
	Cnidaria, Hexacor., Scleractinia	2	x								F	broken, dead
	Scyphozoa, Coronata	1	x								F	
	Hydrozoa, Hydroida	1		x							F	
	Crustacea, Isopoda	4	x								F	
	Crustacea, Galatheidae	1				x					F	
	Bryozoa	>10			x						F	
	invertebrate egg?	1	x								F	

STATION 24. PALMER SEAMOUNT
NW side of highest small cone W of end of Palmer ridge
Dredge on bottom UTC 21/12/02 1107hrs, lat 39º31.209'S, long 178º34.994'W, depth 3202m
Dredge off bottom UTC 21/12/02 1148hrs, lat 39º31.412'S, long 178º34.698'E, depth 2912m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted					x					F	

STATION 25. PALMER SEAMOUNT
NW side of small twin cone at tip of Palmer ridge, south of main seamount.On HKDC1 seismic line
Dredge on bottom UTC 21/12/02 1405hrs, lat 39º31.641'S, long 178º29.951'W, depth 3134m
Dredge off bottom UTC 21/12/02 1453hrs, lat 39º31.884'S, long 178º29.672'W, depth 2881m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Cnidaria, Siphonophora	1			x						F	*Physalia,* from plankton
Meiofauna	unsorted					x					F	

STATION 26. LANGE SEAMOUNT
Small cone at SW base
Dredge on bottom UTC 22/12/02 0145hrs, lat 39º06.09'S, long 177º30.20'W, depth 3509m
Dredge off bottom UTC 22/12/02 0255hrs, lat 39º06.14'S, long 177º30,49'W, depth 3285m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1	x								F	

STATION 27. LANGE SEAMOUNT
Small cone on SW edge Lange plateau
Dredge on bottom UTC 22/12/02 0516hrs, lat 39º03.30'S, long 177º28.01'W, depth 2644m
Dredge off bottom UTC 22/12/02 0631hrs, lat 39º02.95'S, long 177º28.10'W, depth 2338m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Tunicata	5						x			F	*Pyrosoma,* from plankton

STATION 28. LANGE SEAMOUNT
NE trending canyon on E flank of seamount
Dredge on bottom UTC 22/12/02 1059hrs, lat 39º02.080'S, long 177º15.881'W, depth 3102m
Dredge off bottom UTC 22/12/02 1147hrs, lat 39º02.180'S, long 177º16.354'W, depth 2922m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Mollusca, Pteropoda	1			x						F	shell, from sediment sample
Meiofauna	unsorted					x					F	

STATION 29. KATZ SEAMOUNT
Head of E trending canyon on E side of seamount
Dredge on bottom UTC 22/12/02 1714hrs, lat 38º46.519'S, long 176º57.421'W, depth 3116m
Dredge off bottom UTC 22/12/02 1814hrs, lat 38º46.269'S, long 176º57.699'W, depth 2828m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	2	x								F	2 species
	Polychaeta	3	x								F	tubes with forams
	Mollusca, Bivalvia	1	x								F	shell broken
	Sipuncula	1	x								F	
Meiofauna	unsorted					x					F	

STATION 30. MULDOON SEAMOUNT
Small canyon on E side of seamount
Dredge on bottom UTC 23/12/02 0435hrs, lat 38º30.45'S, long 176º34.90'W, depth 3634m
Dredge off bottom UTC 23/12/02 0535hrs, lat 38º30.20'S, long 176º35.22'W, depth 3341m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Polychaeta	1		x							F	from sediment sample
Meiofauna	unsorted					x					F	

STATION 31. MARSHALL SEAMOUNT
East flank
Dredge on bottom UTC 23/12/02 1938hrs, lat 38º2.14'S, long 177º28.75'W, depth 2974m
Dredge off bottom UTC 23/12/02 2044hrs, lat 38º01.99'S, long 177º29.43'W, depth 2587m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Cnidaria, Siphonophora	1						x			F	on cable, from plankton
	Tunicata, *Pyrosoma*	1						x			F	from plankton

STATION 32. KIWI RIDGE A
Top area, 4th small hill from south small canyon
Dredge on bottom UTC 25/12/02 0259hrs, lat 36º18.8'S, long 178º49.2'W, depth 4443m
Dredge off bottom UTC 25/12/02 0416hrs, lat 36º18.743'S, long 178º49.948'W, depth 4133m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Polychaeta	7		x							F	tubes
	Sipuncula	1	x								F	
	Tunicata, *Pyrosoma*	2					x				F	
Meiofauna	Nematoda	35									F	
	Copepoda	5									F	
	Ostracoda	1									F	
	unidentified worm-like organisms	1									F	
	Tardigrada	2									F	

STATION 33. KIWI RIDGE B
5th cone, upper eastern slope
Dredge on bottom UTC 25/12/02 0715hrs, lat 36º16.93'S, long 178º49.05'W, depth 4470m
Dredge off bottom UTC 25/12/02 0815hrs, lat 36º16.914'S, long 178º49.568'W, depth 4139m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	25									F	
	Copepoda	5									F	
	Crustacea	1									F	
	Annelida	4									F	
	unidentified worm-liek organisms	1									F	
	Insecta	1									F	

STATION 34. RAPUHIA SCARP A
Steep, single scarp
Dredge on bottom UTC 25/12/02 1439hrs, lat 35º59.497'S, long 178º31.199'W, depth 6182m
Dredge off bottom UTC 25/12/02 1644hrs, lat 36º00.027'S, long 178º31.875'W, depth 5399m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	4		x*							F	Hexactinellida??, *blue cap tube
	Porifera?	2	x								F	cup-shaped, yellowish
	Anthozoa, Hexacor., Actiniaria?	1	x								F	
	Scyphozoa, Coronata?	11	x								F	in 2 vials
	Polychaeta	2	x								F	
Meiofauna	Nematoda	4									F	
	Copepoda	6									F	
	Annelida	1									F	
	unidentified worm-like organisms	10									F	

STATION 35. MOA SEAMOUNT
SE flank towards top
Dredge on bottom UTC 25/12/02 2223hrs, lat 36º02.05'S, long 178º16.55'W, depth 5918m
Dredge off bottom UTC 26/12/02 0011hrs, lat 36º01.45'S, long 178º17.22'W, depth 5167m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Anthozoa, Hexacor., Actiniaria	1	x								F	
	Scyphozoa, Coronata	1		x							F	
Meiofauna	Nematoda	54									F	
	Copepoda	1									F	
	Annelida	5									F	
	unsorted					X					F	

STATION 36. RAPUHIA SCARP B
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 0436hrs, lat 36º02.28'S, long 178º28.12'W, depth 6001m
Dredge off bottom UTC 26/12/02 0606hrs, lat 36º02.63'S, long 178º28.69'W, depth 5478m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Anthozoa, Octocorallia	1		x							F	
	Anthozoa, Actiniaria	1	x								F	
	Scyphozoa, Coronata?	4	x								F	same as in 34
	Scyphozoa, Coronata	1	x								F	
	Mollusca?	1		x							F	egg capsule?

STATION 37. NW RAPUHIA C
Small canyon a few km S of DR34
Dredge on bottom UTC 26/12/02 1112hrs, lat 36º07.242'S, long 178º23.484'W, depth 5868m
Dredge off bottom UTC 26/12/02 1305hrs, lat 36º07.223'S, long 178º23.492'W, depth 5820m
no sediment, no macrofauna

STATION 38. NW RAPUHIA D
few miles SE of DR37
Dredge on bottom UTC 26/12/02 1844hrs, lat 36º22.54'S, long 178º07.787'W, depth 5609m
Dredge off bottom UTC 26/12/02 1956hrs, lat 36º23.12'S, long 178º08.22'W, depth 5028m
sediment, no macrofaunal organisms

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Nematoda	5									F	
	Copepoda	2									F	
	unidentified worm-like organisms	2									F	

STATION 39. NW RAPUHIA E
ca. 1,5 nm E of DR38
Dredge on bottom UTC 26/12/02 2342hrs, lat 36º23.02'S, long 178º06.60'W, depth 5578m
Dredge off bottom UTC 27/12/02 0124hrs, lat 36º23.60'S, long 178º07.25'W, depth 5017m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1	x								F	

STATION 40. TUATARA
NW slope, from upper base to top
Dredge on bottom UTC 27/12/02 0708hrs, lat 36º28.03'S, long 177º43.10'W, depth 5076m
Dredge off bottom UTC 27/12/02 0807hrs, lat 36º28.39'S, long 177º42.92'W, depth 4728m
no sediment, no macrofauna

STATION 41. SAVAGE A
E side of volcanic ridge marking edge of plateau; northern site
Dredge on bottom UTC 27/12/02 1212hrs, lat 36º38.033'S, long 177º47.502'W, depth 4107m
Dredge off bottom UTC 27/12/02 1328hrs, lat 36º38.173'S, long 177º48.173'W, depth 3555m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	6			x						F	
	Scyphozoa, Coronata	1	x								F	
	Anthozoa, Octocorallia?	1		x							F	
	Polychaeta	2	x								F	
	Bryozoa?	1	x								F	

STATION 42. SAVAGE B
E side of volcanic ridge marking edge of plateau; southern site
Dredge on bottom UTC 27/12/02 1620hrs, lat 36º40.717'S, long 177º46.106'W, depth 3845m
Dredge off bottom UTC 27/12/02 1757hrs, lat 36º40.628'S, long 177º46.729'W, depth 3407m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	>20	x								F	two species
	Porifera	>10		x							F	
	Polychaeta	2	x								F	
	Bryozoa	>10	x								F	
	Bryozoa?	1		x*							F	blue cap vial
	Tunicata?	2	x								F	
	Pisces	1	x								F	a single tooth; shark?

STATION 43. KIORE
NW side
Dredge on bottom UTC 28/12/02 0138hrs, lat 36º38.962'S, long 177º13.008'W, depth 4718m
Dredge off bottom UTC 28/12/02 0329hrs, lat 36º39.364'S, long 177º12.219'W, depth 4184m
sediment, no macrofauna

Meiofauna	Nematoda	14									F	
	Ostracoda	1									F	
	Annelida	2									F	
	unidentified worm-like organisms	3									F	

STATION 44. SE RAPUHIA A
Rapuhia Scarp, SE Region, Nr 7 of Christmas mappimg, ΔH= 900 m over 1.2 nm
Dredge on bottom UTC 28/12/02 0906hrs, lat 37º07,527'S, long 177º07,864'W, depth 4976m
Dredge off bottom UTC 28/12/02 1034hrs, lat 37º07,993'S, long 177º08,423'W, depth 4280m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Forams	4	x								F	on a sponge stalk?
	Porifera	>10						x			F	parts, Demospongia, Hexactin.
	Porifera	5		x							F	Hexactinellida??
	Anthozoa, Octocorallia?	3	x								F	
	Polychaeta	1	x								F	
	Bryozoa	1		x							F	

STATION 45. SE RAPUHIA B
Steepest slope on plateau nose
Dredge on bottom UTC 28/12/02 1615hrs, lat 37º08.946'S, long 176º43.844'W, depth 5039m
Dredge off bottom UTC 28/12/02 1813hrs, lat 37º09.639'S, long 176º44.063'W, depth 4310m
no sediment, no macrofauna

STATION 46. PENGUIN A
Southeastern slope from base to top
Dredge on bottom UTC 29/12/02 1843hrs, lat 40º39.956'S, long 173º46.808'W, depth 2999m
Dredge off bottom UTC 29/12/02 1937hrs, lat 40º39.50'S, long 173º47.00'W, depth 2673m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Polychaeta	1	x								F	
	Tunicata, *Pyrosoma*	2					x				F	from plankton
Meiofauna	Nematoda	25									F	
	Copepoda	5									F	
	Annelida	1									F	
	unidentified worm-like organisms	1									F	

STATION 47. PENGUIN B
Northeastern slope, bottom of small valley from base to top
Dredge on bottom UTC 29/12/02 2206hrs, lat 40º37.70'S, long 173º45.05'W, depth 3134m
Dredge off bottom UTC 29/12/02 2320hrs, lat 40º37.75'S, long 173º45.90'W, depth 2757m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	2	x								F	Hexactinellida??
	Polychaeta	4		x							F	
	Bryozoa	~10		x							F	
Meiofauna	Nematoda	32									F	
	Copepoda	2									F	
	Annelida	4									F	
	unidentified worm-like organisms	4									F	
	Tardigrada	1									F	

STATION 48. POLAR BEAR A
Dredge on bottom UTC 30/12/02 1007hrs, lat 41º31.18'S, long 173º57.08'W, depth 2504m
Dredge off bottom UTC 30/12/02 1140hrs, lat 41º30.77'S, long 173º57.98'W, depth 2082m
sediment, no macrofauna

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Tunicata, *Pyrosoma*	1					x				F	from plankton
Meiofauna	unsorted					x					F	

STATION 49. POLAR BEAR B
Small canyon at western slope;steepest structure
Dredge on bottom UTC 30/12/02 1616hrs, lat 41º27.87'S, long 174º11.89'W, depth 2710m
Dredge off bottom UTC 30/12/02 1809hrs, lat 41º27.81'S, long 174º10.93'W, depth 2072m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	>10		x							F	Demospongia, Hexactinellida??
	Scyphozoa, Coronata	1	x								F	
	Polychaeta	5	x								F	
	Bryozoa	>10		x							F	
	Brachiopoda	2	x								F	*Novocrania* sp.
	?	2	x								F	possibly Hydrozoa?
Meiofauna	unsorted					x					F	
fossil corals		3										symbiontic form of Madrepora

STATION 50. POLAR BEAR C
Northwestern sid, ca. 2.5nm north of DR49
Dredge on bottom UTC 30/12/02 2035hrs, lat 41º25.44'S, long 174º11.34'W, depth 2438m
Dredge off bottom UTC 30/12/02 2138hrs, lat 41º25.43'S, long 174º10.91'W, depth 2135m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted					x					F	

STATION 51. TV Grab, GTV A
Plateau of Polar Bear seamount
TV-grab over side UTC 30/12/02 2321hrs, lat 41º26.25'S, long 174º7.08'W, depth 1842m
TV-grab on bottom UTC 30/12/02 2348hrs, lat 41º26.36'S, long 174º7.05'W, depth 1840m
TV-grab closed UTC 30/12/02 0020hrs, lat 41º26.12'S, long 174º7.05'W, depth 1849m
TV-grab of bottom UTC 31/12/02 0021hrs, lat 41º26.12'S, long 174º7.05'W, depth 1849m
TV-grab on deck UTC 31/12/02 0056hrs, lat 41º26.10'S, long 174º7.10'W, depth 1847m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1									F	Dead hexactinellid sponge
	Polychaeta	1									F	
Meiofauna	Nematoda	101									F	
	Copepoda	28									F	
	Crustacea	3									F	
	Annelida	7									F	
	unidentified worm-like organisms	32									F	
	Kinorhyncha	4									F	
	Cnidaria?	1									F	
	unsorted						x				F	

STATION 52. TV Grab, GTV A
2.5 nm SW of TV Grab 51 on Polar Bear Plateau
TV-grab over side UTC 31/12/02 0127hrs, lat 41º28.16'S, long 174º10.02'W, depth 1965m
TV-grab on bottom UTC 31/12/02 0202hrs, lat 41º28.13'S, long 174º9.97'W, depth 1957m
TV-grab closed UTC 31/12/02 0212hrs, lat 41º28.04'S, long 174º9.99'W, depth 1959m
TV-grab of bottom UTC 31/12/02 0213hrs, lat 41º28.04'S, long 174º9.99'W, depth 1958m
TV-grab on deck UTC 31/12/02 0255hrs, lat 41º28.10'S, long 174º9.98'W, depth 1958m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1				x					F	Hexactinellida??, in 2 parts
	Polychaeta	~10				x					F	mainly nereids
	Polychaeta	2	x								F	
	Sipuncula	1				x					F	large, poss. 2 more in Polych.
	Crustacea, Amphipoda?	1		x							F	
	Echinodermata, Echinoidea	1				x					F	irregular, burrowing urchin
	?	2*		x							F	elastic tube, no animal inside * only 1 preserved, broken
Meiofauna	unsorted					x					F	

STATION 53. Box Corer, GKG
same site as TV Grab 52
box corer over side UTC 31/12/02 0310hrs, lat 41º28.07'S, long 174º09.99'W, depth 1958m
box corer on bottom UTC 31/12/02 0354hrs, lat 41º28.11'S, long 174º09.97'W, depth 1957m
box corer closed: no data
box corer of bottom UTC 31/12/02 0354hrs, lat 41º28.11'S, long 174º09.97'W, depth 1957m
box corer on deck UTC 31/12/02 0428hrs, lat 41º28.11'S, long 174º09.98'W
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Polychaeta	3		x							F	
	Polychaeta	1		x							F	1 animal in 3 parts
	Crustacea	1	x								F	head missing
	Crustacea, Isopoda, *Gnathia* sp.	2	x								F	1 male, 1 female with eggs
	Echinodermata, Ophiuroidea	1	x								F	
Meiofauna	unsorted						2x				F	

STATION 54 WISHBONE Ridge
Dredge on bottom UTC 31/12/02 0053hrs, lat 40º38,53'S, long 169º44,34'W, depth 3750m
Dredge off bottom UTC 31/12/02 0236hrs, lat 40º38,05'S, long 169º44,96'W, depth 3030m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	6		x							F	1 hexact., 5 parts of demospon.
	Bryozoa	3	x								F	
Meiofauna	unsorted					x					F	

STATION 55 WISHBONE Ridge
southern part, SE slope, upper part to top
Dredge on bottom UTC 01/01/03 0533hrs, lat 40º45,16'S, long 169º49,68'W, depth 3300m
Dredge off bottom UTC 01/01/03 0723hrs, lat 40º45,12'S, long 169º49,66'W, depth 3340m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	3		x							F	
	Scyphozoa, Coronata	2	x								F	
	Bryozoa	1	x								F	colour: pink

STATION 56 WISHBONE Ridge
southwestern corner of Wishbone ridge
Dredge on bottom UTC 01/01/03 0957hrs, lat 40º45,89'S, long 169º50,57'W, depth 3548m
Dredge off bottom UTC 01/01/03 1132hrs, lat 40º45,39'S, long 169º50,70'W, depth 2752m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted					x					F	

STATION 57 Chicken seamount
eastern slope
Dredge on bottom UTC 01/01/03 1742hrs, lat 41º03,44'S, long 169º05,34'W, depth 2796m
Dredge off bottom UTC 01/01/03 1900hrs, lat 40º03,49'S, long 169º05,94'W, depth 2390m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	1	x								F	Hexactinellida??
Meiofauna	unsorted					x					F	

STATION 58. PUKEKO
Northeastern Corner, east facing slope
Dredge on bottom UTC 02/01/03 0249hrs, lat 41º43.84'S, long 169º17.18'W, depth 3710m
Dredge off bottom UTC 02/01/03 543hrs, lat 41º43.99'S, long 169º16.99'W, depth 3670m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Porifera	8			x						F	pieces of hexac. and demosp.
Meiofauna	unsorted					x					F	

STATION 59. WETA A
Northeastward facing slope of biggest WETA seamount
Dredge on bottom UTC 02/01/03 1426hrs, lat 42º11.93'S, long 168º50.90'W, depth 2907m
Dredge off bottom UTC 02/01/03 1540hrs, lat 42º12.42'S, long 168º51.16'W, depth 2436m
no sediment, no macrofauna

STATION 60 WETA B
Another biggish seamount, 4 miles SSW
Dredge on bottom UTC 02/01/03 1807hrs, lat 42º15,51'S, long 168º52,47'W depth 2855m
Dredge off bottom UTC 02/01/03 1853hrs, lat 42º15,71'S, long 168º53,01'W, depth 2570m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Brachiopoda	1			x						EtOH	*Eucalathis* sp.

STATION 61 KAKAPO SEAMOUNT
Western seamount flank
Dredge on bottom UTC 03/01/03 0624hrs, lat 43º28,44'S, long 168º37,35'W depth 3174m
Dredge off bottom UTC 03/01/03 0731hrs, lat 43º28,29'S, long 168º36,16'W, depth 2755m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	unsorted					x					F	

STATION 62 TAKAHE PLATEAU
Across Nose of Northwestern Plateau Margin
Dredge on bottom UTC 03/01/03 1259hrs, lat 43º03,87'S, long 168º45,60W depth 3102m
Dredge off bottom UTC 03/01/03 1425hrs, lat 43º03,56'S, long 168º44,87'W, depth 2441m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Mollusca, Bivalvia	1			x						EtOH	same jar as brachiopods
	Brachiopoda	5			x						EtOH	*Eucalathis* sp.
	Brachiopoda, *Eucalathis* sp.	1	x								EtOH	was almost dried out

STATION 63 Kakapo seamount
SE slope
Dredge on bottom UTC 03/01/03 1916hrs, lat 43º29,67'S, long 168º32,51W depth 3221 m
Dredge off bottom UTC 03/01/03 2037hrs, lat 43º29,42'S, long 168º33,17'W, depth 2830m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 64. KIEL SEAMOUNT
Rift at eastern slope towards plateau
Dredge on bottom UTC 03/01/03 0211hrs, lat 43º40.64'S, long 168º12.79W, depth 3778 m
Dredge off bottom UTC 03/01/03 0439hrs, lat 43º41.15'S, long 168º13.95'W, depth 3411m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted					2x					F	

STATION 65. HAMBURG SEAMOUNT
Dredge on bottom UTC 04/01/03 16:15hrs, lat 44º31.15'S, long 170º23,39W, depth 3798 m
Dredge off bottom UTC 04/01/03 17:57hrs, lat 44º31,70'S, long 170º2,51'W, depth 3271m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 66. ERIK SEAMOUNT
South eastern slope just below plateau
Dredge on bottom UTC 05/01/03 0817hrs, lat 44º45.60'S, long 172º05,59'W, depth 2926 m
Dredge off bottom UTC 04/01/03 17:57hrs, lat 44º31,70'S, long 170º2,51'W, depth 2434m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					⨯					F	

STATION 67. FRANKFURT
Eastern slope, upper base
Dredge on bottom UTC 05/01/03 1830hrs, lat 45º37.37'S, long 172º35.63'W, depth 4030m
Dredge off bottom UTC 05/01/03 1949hrs, lat 45º36.94'S, long 172º36.22'W, depth 3560m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					⨯					F	

STATION 68. STUTTGART
Top
TV-grab over side UTC 6/1/03 0140hrs, lat 45º29.368'S, long 173º22.568'W, depth 3940m, cable 0m
TV-grab on bottom UTC 6/1/03 0245hrs, lat 45º29.349'S, long 173º22.690'W, depth 3946m, cable 3927m
TV-grab closed UTC 6/1/03 0318hrs, lat 45º29.290'S, long 173º22.744'W, depth 3951m, cable 3956m
TV-grab on deck UTC 6/1/03 0440hrs, lat 45º29.326'S, long 173º22.748'W, depth 3947m, cable 0m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 69. STUTTGART
Top
box corer over side UTC 6/1/03 0504hrs, lat 45º29.300'S, long 173º22.738'W, depth 3948m, cable 0m
box corer on bottom UTC 6/1/03 0620hrs, lat 45º29.309'S, long 173º22.722'W, depth 3951m, cable 3948m
box corer on deck UTC 6/1/03 0725hrs, lat 45º29.223'S, long 173º22.392'W, depth 3941m, cable 0m
no sediment, no macrofauna

STATION 70. STUTTGART A
Southeastern slope
Dredge on bottom UTC 06/01/03 0939hrs, lat 45º29.32'S, long 173º14.20'W, depth 4591m
Dredge off bottom UTC 06/01/03 1107hrs, lat 45º28.95'S, long 173º14.55'W, depth 3956m
no sediment, no macrofauna

STATION 71. STUTTGART B
Southeastern corner, upper slope
Dredge on bottom UTC 06/01/03 1352hrs, lat 45º29.57'S, long 173º15.64'W, depth 4240m
Dredge off bottom UTC 06/01/03 1506hrs, lat 45º29.07'S, long 173º15.71'W, depth 3654m
no sediment, no macrofauna

STATION 72 MÜNCHEN
Valley at upper eastern slope
Dredge on bottom UTC 07/01/03 0025hrs?, lat 44º42.86'S, long 174º02.80'W, depth 2286m
Dredge off bottom UTC 07/01/03 0127hrs, lat 44º42.99'S, long 174º03.60'W, depth 1979m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 73. WESTERN UPRISING
Northeastern shallow slope
Dredge on bottom UTC 07/01/03 0704hrs, lat 44º12.99'S, long 174º28.22'W, depth 965m
Dredge off bottom UTC 07/01/03 0811hrs, lat 44º13.22'S, long 174º28.90'W, depth 874m (posn when stuck dredge was freed)
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	3										Milleporidae; Isididae; *Goniocorella* sp.

STATION 74. CHAPMANS HILL
Northeastern slope of northern peak
Dredge on bottom UTC 07/01/03 1053hrs, lat 44º09.08'S, long 174º32.85'W, depth 871m
Dredge off bottom UTC 07/01/03 1154hrs, lat 44º09.40'S, long 174º33.02'W, depth 610m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals										F	Milleporidae; Madrepora oculata; solitary corals

STATION 75. UNLUCKY HILL
SW slope
Dredge on bottom UTC 07/01/03 1810hrs, lat 44º21.87'S, long 174º58.22'W, depth 742m
Dredge off bottom UTC 07/01/03 1841hrs, lat 44º21.649'S, long 174º57.977'W, depth 457m
no sediment, no macrofauna

STATION 76. HOWSON A
Northern edge of main top
Dredge on bottom UTC 07/01/03 2349hrs, lat 43º56.12'S, long 175º18.16'W, depth 134m
Dredge off bottom UTC 08/01/03 0005hrs, lat 43º56.216'S, long 175º18.202'W, depth 98m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted											
	corals											solitary; fragmented
Meiofauna	unsorted					x					F	

STATION 77. HOWSON B
Northeastern edge of main top
Dredge on bottom UTC 08/01/03 0050hrs, lat 43º56.369'S, long 175º17.618'W, depth 130m
Dredge off bottom UTC 08/01/03 0116hrs, lat 43º56.357'S, long 175º17.676'W, depth 120m
no sediment, no macrofauna

STATION 78. HOWSON C
North side of small cone to east of main top
Dredge on bottom UTC 08/01/03 0145hrs, lat 43º56.656'S, long 175º17.296'W, depth 127m
Dredge off bottom UTC 08/01/03 0222hrs, lat 43º56.690'S, long 175º17.308'W, depth 104m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 79. HOWSON D
NW side of small cone to SW of main top
Dredge on bottom UTC 08/01/03 0308hrs, lat 43º57.195'S, long 175º18.889'W, depth 112m
Dredge off bottom UTC 08/01/03 0322hrs, lat 43º57.262'S, long 175º18.867'W, depth 103m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	1										*Flabellum*

STATION 80. CHARLTON A
Northern dredge on slope
Dredge on bottom UTC 08/01/03 0537hrs, lat 44º11.634'S, long 175º27.948'W, depth 253m
Dredge off bottom UTC 08/01/03 0604hrs, lat 44º11.733'S, long 175º27.889'W, depth 161m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals											Mileporidae; *Madrepora oculata*

STATION 81. CHARLTON B
Southern dredge near top of cone
Dredge on bottom UTC 08/01/03 0723hrs, lat 44º13.78'S, long 175º27.10'W, depth 124m
Dredge off bottom UTC 08/01/03 0747hrs, lat 44º13.86'S, long 175º27.10'W, depth 101m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 82. HICKS
Southwestern slope
Dredge on bottom UTC 08/01/03 1040hrs, lat 44º27.75'S, long 175º21.19'W, depth 515m
Dredge off bottom UTC 08/01/03 1100hrs, lat 44º27.70'S, long 175º21.06'W, depth 386m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 83. FBI
South slope of southern cone
Dredge on bottom UTC 08/01/03 1336hrs, lat 44º40.833'S, long 175º12.754'W, depth 1024m
Dredge off bottom UTC 08/01/03 1423hrs, lat 44º40.517'S, long 175º12.756'W, depth 755m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 84. GORE
SE flank
Dredge on bottom UTC 08/01/03 1807hrs, lat 44º36.673'S, long 175º45.024'W, depth 1192m
Dredge off bottom UTC 08/01/03 1903hrs, lat 44º36.38'S, long 175º45.26'W, depth 884m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 85. MONKHOUSE
~ 2.5 nm east of Monkhouse position, base of ridge-like structure
Dredge on bottom UTC 09/01/03 0216hrs, lat 44º39.75'S, long 176°17.35'W, depth 740m
Dredge off bottom UTC 09/01/03 0240hrs, lat 44º39.78'S, long 176º18.10'W, depth 540m (position when stuck dredge became free)
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals										F	*Flabellum; Desmophyllum*
Meiofauna	unsorted					x					F	

STATION 86. JONES
South-facing nose dredged in NE direction
Dredge on bottom UTC 09/01/03 0757hrs, lat 44º35.835'S, long 176°31.973'W, depth 563m
Dredge off bottom UTC 09/01/03 0824hrs, lat 44º35.787'S, long 176º30.668'W, depth 421m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	10									F	*Goniocorella; Flabellum*
Meiofauna	unsorted					x					F	

STATION 87. PERRY
SE flank of table mountain
Dredge on bottom UTC 09/01/03 1145hrs, lat 44º38.581'S, long 176°49.498'W, depth 684m
Dredge off bottom UTC 09/01/03 1232hrs, lat 44º38.376'S, long 176º49.121'W, depth 511m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	10									F	*Goniocorella*
Meiofauna	unsorted					x					F	

STATION 88. THOMPSON
SW corner, steepest slope
Dredge on bottom UTC 09/01/03 1436hrs, lat 44º44.268'S, long 176°48.072'W, depth 988m
Dredge off bottom UTC 09/01/03 1545hrs, lat 44º43.932'S, long 176º47.751'W, depth 733m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted											
	corals	3										*Solenosmilia* ; *Goniocorella*

STATION 89. CLERKE A
SE slope
Dredge on bottom UTC 10/01/03 0231hrs, lat 43º52.375'S, long 177°07.473'W, depth 127m
Dredge off bottom UTC 10/01/03 0248hrs, lat 43º52.327'S, long 177º07.416'W, depth 84m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	1									F	colonial (*Millepora*)

STATION 90. CLERKE B
Cone or ridge structure S of DR89, SE slope
Dredge on bottom UTC 10/01/03 0347hrs, lat 43º52.877'S, long 177°07.563'W, depth 156m
Dredge off bottom UTC 10/01/03 0432hrs, lat 43º52.847'S, long 177º07.522'W, depth 148m
safety wire broken, dredge lost

STATION 91. MANLEY
SW flank
Dredge on bottom UTC 10/01/03 0951hrs, lat 43º22.090'S, long 177°22.456'W, depth 204m
Dredge off bottom UTC 10/01/03 1019hrs, lat 43º22.023'S, long 177º22,370 'W, depth 189m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 92
plain area on Chatham rise, "carbonate mound" WNW of Chatham islands
TV-grab over side UTC 10/1/03 2136hrs, lat 43º3,645'S, long 178º38,904'W, depth 527m, cable 0m
TV-grab on bottom UTC 10/1/03 2156hrs, lat 43º3,665'S, long 178º39,006'W, depth 528m, cable 517m
TV-grab closed UTC 10/1/03 2205hrs, lat 43º3,659'S, long 178º39,058'W, depth 526m, cable 535m
TV-grab on deck UTC 10/1/03 2221hrs, lat 43º03,60'S, long 178º39,118'W, depth 527m, cable 0m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted										F	

STATION 93
plain area on Chatham rise, "carbonate mound" WNW of Chatham islands
box corer over side UTC 10/1/03 2250hrs, lat 43º03,68'S, long 178º39,06'W, depth 527m, cable 0m
box corer on bottom UTC 10/1/03 2305hrs, lat 43º0368'S, long 178º39,06'W, depth 527m, cable 528m
box corer on deck UTC 10/1/03 2318hrs, lat 43º3,696'S, long 178º39,006'W, depth 526m, cable 0m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted					x					F	

STATION 94.MATHESON Bank
soouthern margin
Dredge on bottom UTC 11/01/03 1403hrs, lat 44º00,35'S, long 179°12,84'W, depth 289m
Dredge off bottom UTC 11/01/03 1416hrs, lat 44º00,346'S, long 179º12,958 'W, depth 285m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 95.MATHESON Bank
southern margin
Dredge on bottom UTC 11/01/03 1504hrs, lat 43º59,926'S, long 179°14,848'W, depth 272m
Dredge off bottom UTC 11/01/03 1540hrs, lat 43º59,751'S, long 179º14,868 'W, depth 252m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	Echinodermata, Asteroidea	2								x	F	1 fragmented, 2 species, orange

STATION 96: VERYAN BANK
northeastern margin
Dredge on bottom UTC 12/01/03 1743hrs, lat 44º03.058'S, long 176°27.666'E, depth 605m
Dredge off bottom UTC 12/01/03 1831hrs, lat 44º03.263'S, long 176º27.608'E, depth 405m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	1									F	*Goniocorella* (allochthonous)
Meiofauna	unsorted										F	

STATION 97: VERYAN BANK
Small cone at base of SE flank of Veryan Bank
Dredge on bottom UTC 12/01/03 2250hrs, lat 44º21.02'S, long 176°11.40'E, depth 575m
Dredge off bottom UTC 12/01/03 2334hrs, lat 44º21.15'S, long 176º11.16'E, depth 400m
no sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals										F	*Goniocorella* ; fragments of *Millepora* ; solitary corals

STATION 98. GATHREY
Small cone at base of S flank of Veryan Bank
Dredge on bottom UTC 13/01/03 0214hrs, lat 44º24.135'S, long 175°55.220'E, depth 490m
Dredge off bottom UTC 13/01/03 0351hrs, lat 44º24.18'S, long 175º55.10'E, depth 420m (best estimate, dredge stuck)
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	3									F	tiny solitary corals; *Millepora* fragments
Meiofauna	unsorted										F	

STATION 99. ANJA VULKAN
300m high cone 5nm SW of Gathrey
Dredge on bottom UTC 13/01/03 0619hrs, lat 44º30.479'S, long 175°51.062'E, depth 731m
Dredge off bottom UTC 13/01/03 0721hrs, lat 44º30.512'S, long 175º50.955'E, depth 644m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals										F	tiny solitary corals; *Millepora* fragments
Meiofauna	unsorted	3									F	

STATION 100. YOUNG NICK (Herzer et al knoll A)
NE part
Dredge on bottom UTC 13/01/03 1809hrs, lat 44º48.79'S, long 174°56.31'W, depth 896m
Dredge off bottom UTC 13/01/03 1856hrs, lat 44º49.07'S, long 174º56.41'W, depth 680m
sediment, no macrofauna

Meiofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	

STATION 101. JORDAN
300m high cone 4 nm NW of Young Nick
Dredge on bottom UTC 13/01/03 2023hrs, lat 44º45.326'S, long 174°52.612'E, depth 853m
Dredge off bottom UTC 13/01/03 2108hrs, lat 44º45.702'S, long 174º52.793'E, depth 610m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted										F	

STATION 102. READING
Small cone, 1.5 nm W of Jordan
Dredge on bottom UTC 13/01/03 2249hrs, lat 44º45.85'S, long 174°51.04'E, depth 821m
Dredge off bottom UTC 13/01/03 2325hrs, lat 44º45.135'S, long 174º51.024'E, depth 631m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted										F	

STATION 103. URRY PLAIN
Plain area among eastern Urry Knolls
TV-grab over side UTC 14/1/03 0010hrs, lat 44º45.273'S, long 174º49.117'W, depth 885m, cable 0m
TV-grab on bottom UTC 14/1/03 0023hrs, lat 44º45.314'S, long 174º49.086'W, depth 885m, cable 872m
TV-grab closed UTC 14/1/03 0040hrs, lat 44º45.211'S, long 174º49.065'W, depth 885m, cable 876m
TV-grab on deck UTC 14/1/03 0057hrs, lat 44º45.271'S, long 174º49.105'W, depth 886m, cable 0m
sediment only, no rocks

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
Meiofauna	unsorted										F	

STATION 104. FORWOOD
Prominent cone, central part of Urry Knolls
Dredge on bottom UTC 14/01/03 0406hrs, lat 44º45.90'S, long 174°23.907'E, depth 770m
Dredge off bottom UTC 14/01/03 0502hrs, lat 44º46.24'S, long 174º23.902'E, depth 594m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals	>10									F	Isididae; *Desmophyllum* ; small solitary corals; *Millepora* fragments
Meiofauna	unsorted										F	

STATION 105. BOOTIE
Prominent cone, central part of Urry Knolls. (Herzer et al knoll C)
Dredge on bottom UTC 14/01/03 0739hrs, lat 44º36.121'S, long 174°14.77'E, depth 719m
Dredge off bottom UTC 14/01/03 0815hrs, lat 44º36.32'S, long 174º14.80'E, depth 597m
sediment

Macrofauna	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
	unsorted										F	
	corals										F	*Millepora* fragments
Meiofauna	unsorted										F	

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